STRATHCONA SITE (FjPi-29) EXCAVATIONS

1978 - B. Newton and J. Pollock
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STRATHCONA SITE (FjPi-29)

EXCAVATIONS 1978, 1979 and 1980

by

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FjPi-29, A PREHISTORIC WORKSHOP SITE IN THE ALBERTA PARKLANDS

by
Barry M. Newton
and
John W. Pollock

Faunal Analysis of FjPi-29

by
Gabriella Prager

1979
Edmonton

ABSTRACT

This monograph delimits the results of the 1978 excavations at FjPi-29 in the Strathcona Science Park near Edmonton, Alberta.

Artificats resulting from controlled surface pickup, patterned auger hole testing and the excavation of ten 2x2 metre units are examined in depth with detailed comparison to other similar sites and interpretations of "intra-site patterning" of lithic remains.

A problem orientated approach, as outlined in the introduction, is summarized in the concluding section, along with some preliminary hypotheses for testing during the continuance of the programme during the 1979 field season.

ACKNOWLEDGEMENTS

This report would not have been possible without the initial discovery of the site by ARESCO Ltd. of Calgary. Acting upon their recommendations, Alberta Culture subsequently undertook an assessment of the site and William J. Wood is to be thanked for his contribution in the early stages of the project.

Deserving of special mention are the people, who through diligence and hard work, made the production of this scientific report possible. A special mention is appropriate for Mr. Wayne Gibbs, excavation supervisor, for his contribution to this endeavour. Serving as field assistants were Martin Enokson, James Goruk, Karin Kouns, and Patricia Warkiewicz. They are to be commended for a job well done.

Appreciation is extended to Mr. Bruce Williams and Rick Mayer of Roman Fodchuk and Associates Ltd. for their aid and interest in the fieldwork.

Thanks is extended to the following personnel of the Archaeological Survey. To Dr. W.J. Byrne for his overall support, to Don Barr for assistance with logistics, and especially to Leon Galenza for mapping the site and drafting the excellent figures presented in this report. Thanks is also extended to G. Hysuick for her fine job in typing the final draft of this paper.

Many others, too numerous to mention, assisted either by helping with the fieldwork or contributing beneficial ideas to the writing of this report.

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INTRODUCTION

SITE SETTING

FjPi-29 is a large undisturbed archaeological site comprised of over 15,960 square metres located on the east bank of the North Saskatchewan River just outside Edmonton's city boundaries in the County of Strathcona (Figure 1). The site is located above the river valley in a parkland zone immediately adjacent to the valley rim. In fact, the site occupies a peninsula created by the juncture of a small side tributary with the main river valley and offers virtually an unrestricted view of the river valley to the southwest (Figure 1). As mentioned, the southern boundary of the site is formed by a deep steep-walled side valley formed by "Pine Creek", a local name. The eastern limits of the site are unknown as a large landfill operation has destroyed all evidence in this area (Figure 2). At present the area is covered by a medium to dense growth of young aspen trees. Fortunately, the site has never been ploughed, which is unusual in the Edmonton region, and this greatly increases the site's potential value. However, some tree clearing was undertaken several years ago. This clearing of mature aspen trees (as evidenced from a small windrow of burned logs) may have been done during winter as the amount of surficial disturbance appears to have been minimal and no disturbance of cultural remains resulted. Other minor disturbances consist of what is assumed to be a former radio transmission or power tower of wood, which no longer exists. All factors considered, the site is relatively undisturbed. Even now (1978), the site receives very little use, there are no noticable human footpaths and numerous grouse, rabbits, deer and hawks are found in the area.

Historic debris are rare, and the few items found seem to relate to coal-mining activities in the river valley just north of the archaeological site.

HISTORY OF SCIENTIFIC INVESTIGATION

The scientific history of FjPi-29, now known as the Strathcona Site, began in October of 1976 when the Capital City Recreation Park Management Committee approved the investigation of the archaeological, historical and

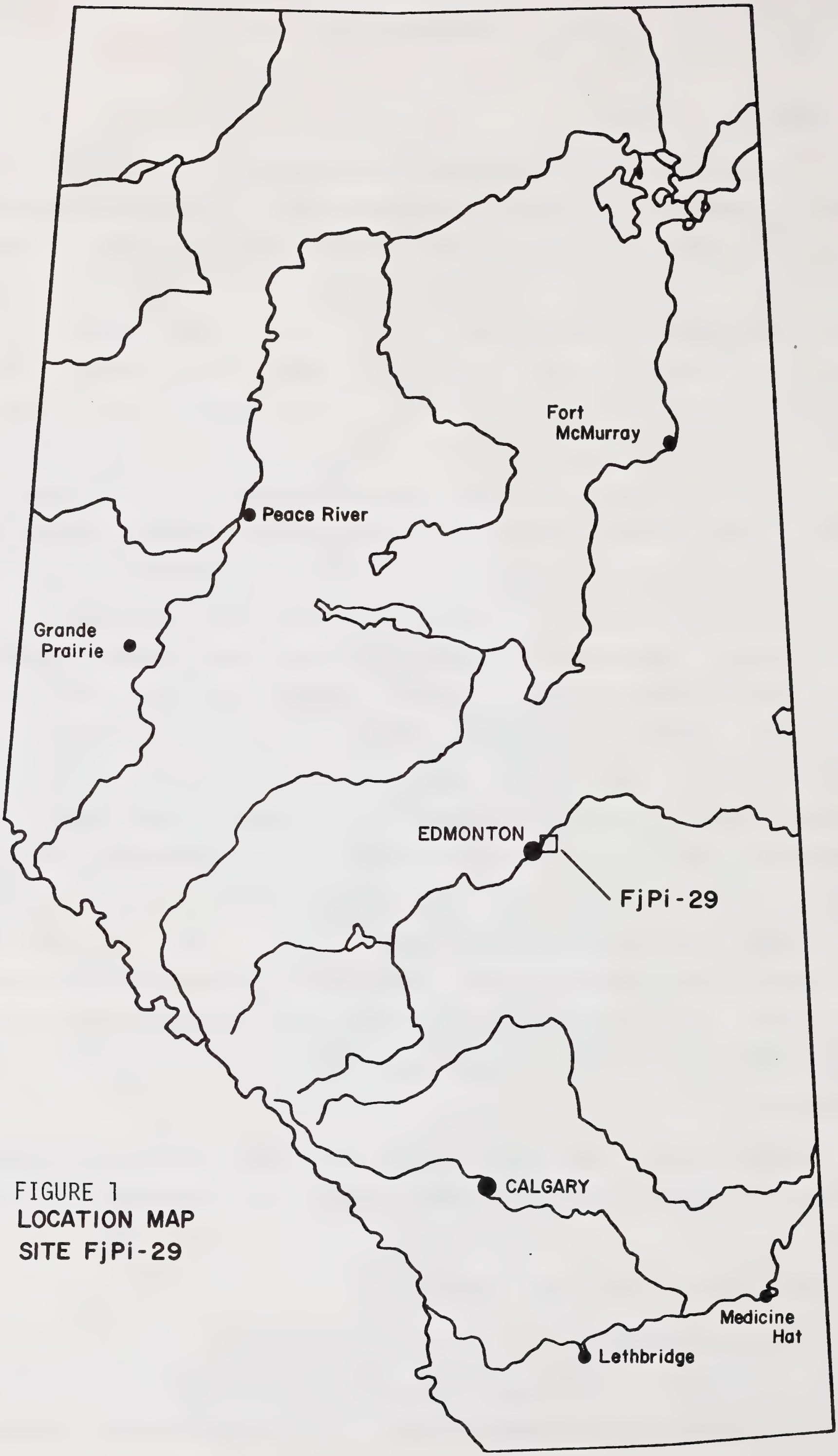


FIGURE 1
LOCATION MAP
SITE FjPi-29

palentological resources in the Capital City Recreation Park areas, so that known, and to-be-determined historic sites could be specifically located, described and evaluated. Furthermore, although some sites were known in the area, prehistoric locations were generally scarce and, therefore, there was a significant scientific interest in having the park area of the Saskatchewan River Valley surveyed. This was especially important since river valleys in general have a significantly high level of historical resource potential. Finally, the possibility of interpretive value of the sites within a park setting was high and very appealing.

The preliminary archaeological survey work was conducted by ARESCO Ltd. of Calgary. Tom Head, who conducted that survey, officially recorded FjPi-29 during November 1976. Subsequently, he returned during May 1977 and undertook fifteen subsurface test holes to a depth of 75 cm. Cultural material was encountered in almost all of the test pits. Mr. Head summarized his findings as follows:

> "The lithic assemblage was predominated by quartzite but lesser quantities of petrified wood were also present. The material from the test holes suggests that the site extends along the valley edge for approximately 150-200 metres and back from its edge for at least 20 metres. Two tools, a quartzite biface and uniface, were encountered in the test holes. The presence of lithic material in almost every test hole suggests a high material density for the site and since the material was encountered in a buried context, additional work will be necessary should any additional disturbance from any cause be anticipated". (Archaeological Survey of Alberta: Original Site Files).

An initial report, Archaeological and Historical Resources Inventory of Goldbar Ravine, Hermitage and Rundle Parks, was completed in 1976 (ARESCO 1976). A follow-up report on the whole of the Capital City Recreation Park Area, Historical Resources Inventory of Capital City Recreation Park, was received in October of 1977 (ARESCO 1977). In this latter report FjPi-29 was the only site to be rated highly in regards to both its scientific investigation potential and its value relative to other sites in the Capital City Recreations area (ARESCO 1977: Volume la, part one, Table 4, page 85). In addition, it was rated as having a high interpretive potential (ARESCO 1977, Volume la, part one, page 94).

FIGURE 2: View of the South-half of FjPi-29 Looking West.

Acting upon the recommendations of ARESCO Ltd., Jim Wood of the Archaeological Survey of Alberta made a preliminary inspection of the site during the fall of 1977. Following this John Pollock, staff archaeologist responsible for the Edmonton area visited the site during early spring 1978. From his subsurface testing it became apparent that this was indeed a major site of high scientific and educational value. Plans were made to initiate immediately a program of site evaluation and assessment.

PROBLEM ORIENTATION OF THE RESEARCH

The project initially fell into the category of an emergency undertaking. That is, the FjPi-29 site in May of 1978 was in immediate danager of destruction from park development. There was a limited time period within which the evaluation and assessment of the site had to be completed if site preservation measures were to be initiated. Faced with such an obstacle, a three step testing program was undertaken. As the eastern edge of the site was slated for road and parking lot, as well as building development, our efforts during the 1978 season were concentrated in these areas. Thus the research was not initially problem orientated in the anthropological sense, but rather was of a technical nature in order to answer questions such as (1) How large was the site? (2) Was it multi-component and what were the cultural affiliations? (3) How deep and how dense were the cultural materials? (4) What type of activities were undertaken there, and what was the prehistoric lifestyle at the site?

It was immediately apparent once testing operations began, that the FjPi-29 site was very large, deeply buried, artifactually productive and relatively undisturbed. As such, it was the only site meeting these standards in the entire inventory of sites known for the Edmonton area.

Early in the fieldwork, the authors began to generate several problems of a theoretical and academic nature. Ideally, these should have been formulated prior to fieldwork initiation but, as the pre-field time was limited to a matter of weeks, this was not possible. However, attempts were made to orientate the operation to known models of the regional archaeological situation and we feel that this was successful.

These problem areas were identified as the following:

1. Was FjPi-29 a quarry or quarry workshop similar to the Stony Plain Quarry site reported by Losey further upstream on the North Saskatchewan, or simply an extensively used campsite (Losey, 1971)?

2. Was the site, despite its large horizontal and relatively deep vertical parameters, primarily a single component site? Could the distribution of lithic types, artifact classes and debitage be used to demonstrate homogeneity?

3. What were the environmental and geographical factors that caused the aboriginal people to select that particular spot for a major campsite? Were location and access to lithic sources and animal concentrations overriding concerns? Could information such as faunal analysis, palynological data and geology help resolve such questions?

4. Given the fact that the site seemed to relate to Plains Archaic people, was the site a regional variant or did it closely resemble other similar sites on the Northwestern Plains?

5. As the site seemed to possess a large lithic workshop element, what was the lithic reduction sequence at the site from cobble splitting to the production of bifacial and unifacial "bust off" preforms and finished artifacts?

6. Could data lacking, or unconfirmed by the examination of the artifactual record of stone tool manufacturing, be compensated for by undertaking experimental archaeology relating to cobble core reduction and biface production?

7. By utilizing technological variables in the stone tools, intra-site variation in deposition of remains and stratigraphic data, could intra-site activity areas be identified?

8. Could identification of manufacturing methods when compared to other similar sites comprise the basis of techno-traditions? In conjunction with standard archaeological data could this lead to the conceptualization of regional plains archaic spheres of cultural development pertaining to different socio-cultural or biological/linguistic groups?

Although none of the problems outlined operate at the level of a

hypothesis (with the possible exception of item 8) this report has addressed itself to providing the answers to the problems outlined as fully as the available data will allow. Subsequent to this initial problem solving stage, it is anticipated that future research at the site based on known data will be able to operate in a more concise theoretical framework.

ARCHAEOLOGICAL EXCAVATIONS AND STRATIGRAPHY

EXCAVATIONS

Acting upon the recommendation of ARESCO Ltd., Pollock, staff archaeologist with the Archaeological Survey of Alberta visited the site on April 14, 1978 and made a preliminary inspection. Previously, ARESCO had conducted several subsurface tests and recovered nineteen pieces of lithic material. During Pollock's preliminary visit he noticed several areas which contained faunal remains as well as bipolar cores and bifaces "in situ" on the surface. The entire site was covered with a large quantity of lithic debris. ARESCO Ltd. estimated the site to be greater than 500 metres in size and even this preliminary assessment indicated their estimate to be a very conservative one. Pollock subsequently recommended that the Archaeological Survey of Alberta excavate a total of 10 - 2x2 metre units or 40 one metre units on this site to be followed by further excavations, if warranted. Work was to begin May 1, 1978 and to continue until completed. (Letter to Dr. W.J. Byrne from John Pollock dated April 17, 1978: on file at A.S.A.).

The sheer size of the site presented several problems in assessment and evaluation. Eventually three sampling strategies were arrived at. The first sampling strategy consisted of surveying a number of transects across the site, 20 metres apart, in a north-south direction. Towards the west side of the site, the orientation of the transects changed to an east-west alignment and a 15 metre spacing (Figure 3). A power auger was used to drill standard 8 inch holes along these lines. The horizontal location, depth of hole and artifacts recovered were recorded. This gave a preliminary idea of the density and distribution of cultural material across the site as well as the extent of the site itself. Use of this method gave positive data indicating that the site, estimated by ARESCO

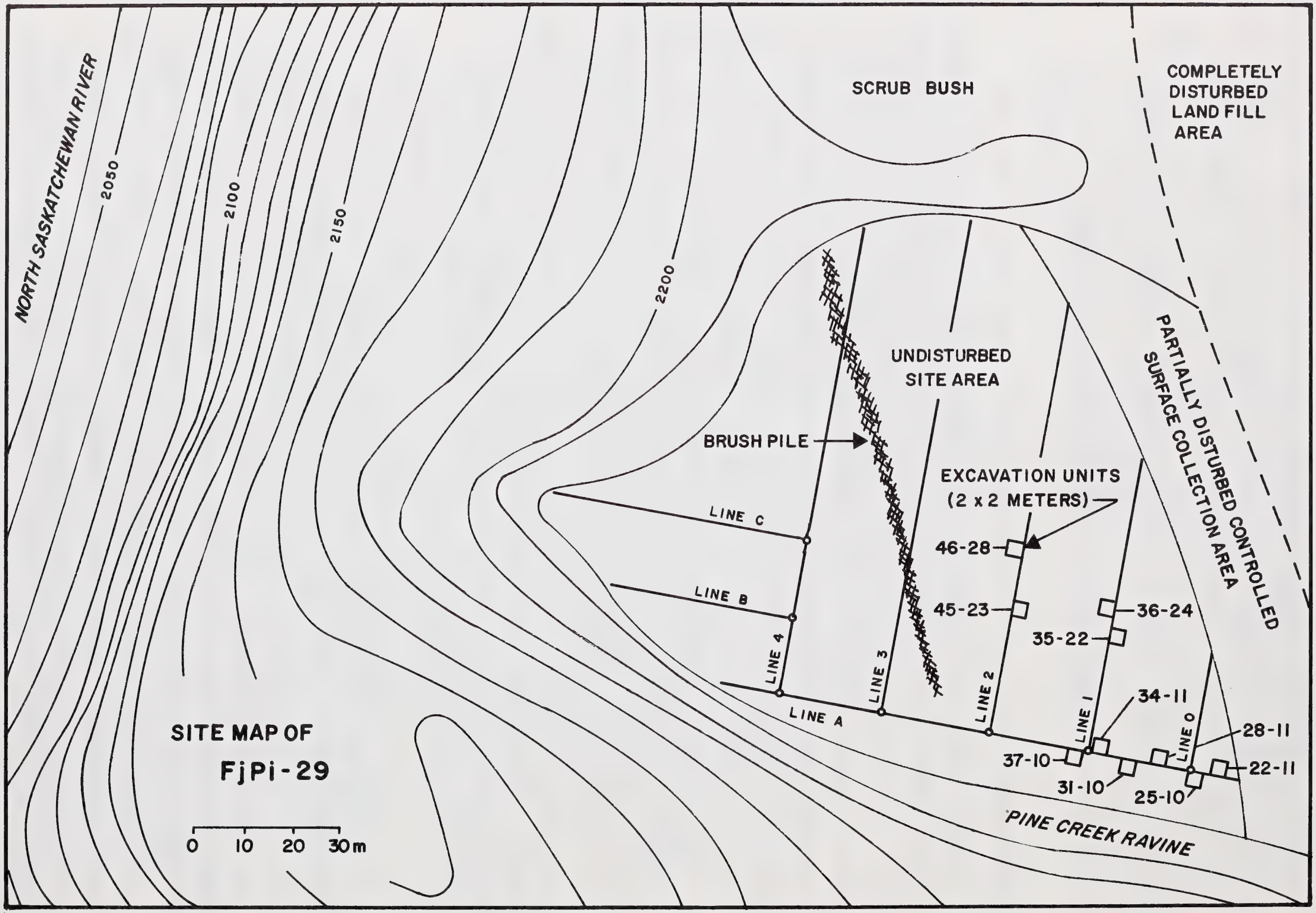


FIGURE 3: SITE MAP OF FjPi-29, STRATHCONA SCIENCE PARK

Ltd. to be about 500 square metres, was in fact a minimum of 15,960 square metres in size. Data resulting from the auger hole testing is presented in Appendix One.

The second testing method involved a controlled surface pickup utilizing triangulation within large 10 metre by 10 metre squares (See Figure 3). The only late prehistoric materials from the site were recovered in this area, perhaps indicating that the late prehistoric component may be scattered across the site in a discontinuous horizontal pattern or, alternatively, it may be restricted to one particular portion of the site. Analysis of surface and excavated specimens indicates that in any event the late materials form only a minor portion of the prehistoric remains present.

The third testing method involved formal excavation. As the eastern edge of the site was specifically under threat of impact by park development, controlled block excavations were undertaken in this area (Figure 3). Altogether, ten 2x2 metre units were excavated to an average depth of 40-50 cm. All excavations were dug by hand with trowels. Shovels were only used to remove the leaves and grass from the top few centimetres. The soil was removed in arbitrary 10 cm horizontal levels. In some cases power screens were used to process backdirt from the excavations but as virtually no specimens were being missed by the trowelling, this was discontinued.

Floor plans were used to record provenience for each cultural item encountered during excavation of the level. A representative floor plan for level 4 (30-40 cm below surface) of units 22-11 is presented as Figure 4. As excavation units were not continuous or adjacent the horizontal data is not presently conducive to spatial analysis of artifact distribution. During 1979 and future years larger block excavations will however allow for definition and analysis of spatial artifact clusters including generative processes and dispersion patterns. Even a relatively small area such as that illustrated in Figure 4 shows definite patterning and non-random distribution of materials indicating the potential for large scale spatial analysis at the site.

In summary, a large number of high potential 2x2 metre units remain to be excavated at the site. All of the squares dug during 1978 were productive and a total of over 3,500 cultural specimens were recovered,

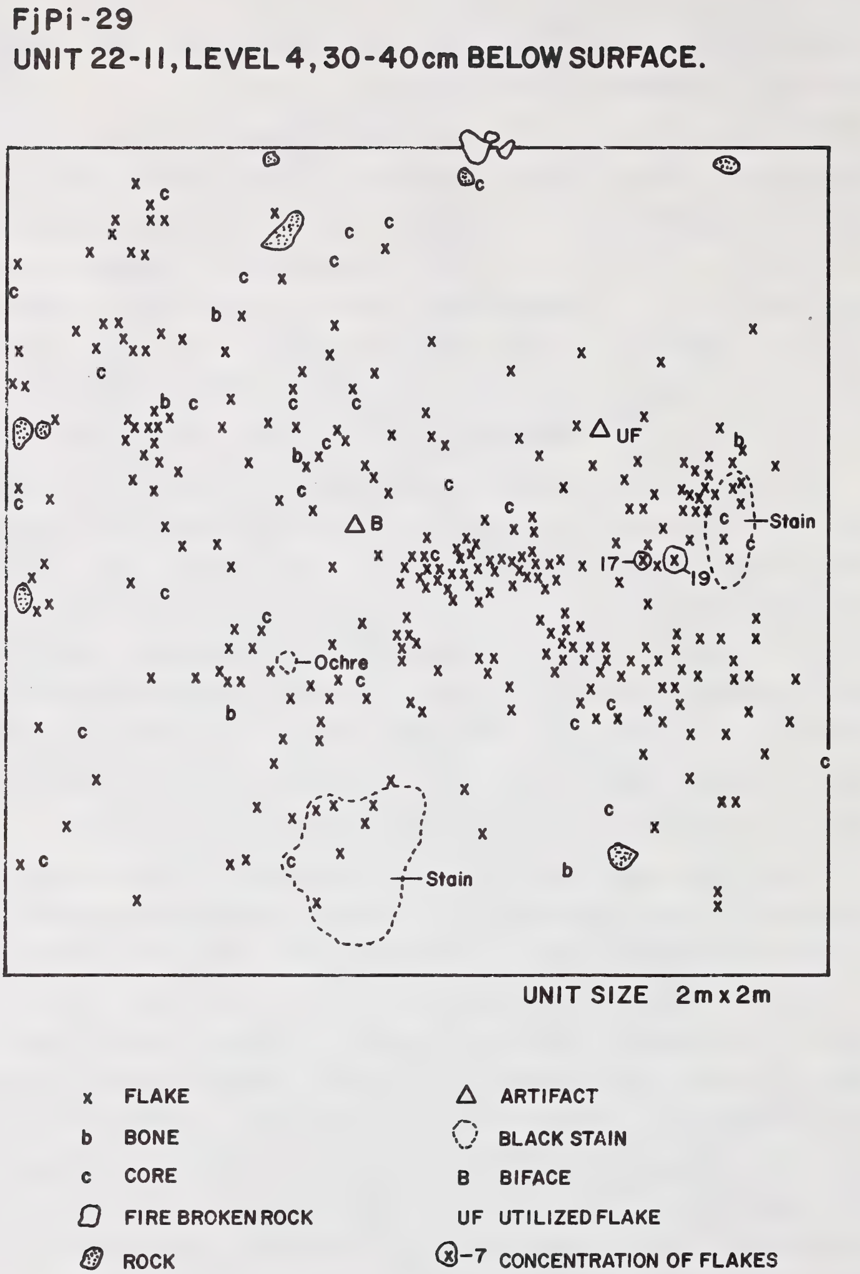


FIGURE 4: FLOOR PLAN OF UNIT 22-11, LEVEL 4 (30-40 cm Below Surface)

including projectile points, bifaces, unifaces, scrapers and faunal remains. Extensive evidence for on site manufacture of tools exists, including the bipolar breaking of quartzite cobbles and the shattering of petrified wood nodules.

The 1978 excavations began on May 8 and ended on June 30, 1978 with an estimated 250 man days of labour being expended during the excavation period.

STRATIGRAPHY

In order to discuss the soil stratigraphy at the site some background data on the surficial geology, soils and geography of the Edmonton area is needed.

The North Saskatchewan River Valley, averaging some 61 metres in depth, is a narrow valley seldom wider than one or two kilometres in width in the vicinity of Edmonton, but is considerably wider downstream from the city. The morphology of the valley (Figure 5), is characterized by terrace development. Within the Edmonton metropolitan area, four postglacial terraces are discernable at the 619, 630, 640, and 65.6 metre levels above the river's surface (Westgate 1969:138). None of these terraces, all of which have been formed in postglacial times, are of immediate interest as the archaeological site FjPi-29 lies above the valley proper and is located on the uppermost terrace or prairie level. These terraces vary from laucustrine clay and silt to till interbedded with reworked saskatchewan sands and gravels (MacPherson and Kathol 1973:4). It would seem that the deposits at the Strathcona site are derived from Glacial Lake Edmonton and consists of silt till, brown till, and gray till in a descending order (Westgate 1969:130).

Soils in this area are generally of the Chernozemic order and can be found on all types of parent material (Environment Canada: Soil Capability for Agriculture Map 83H, Edmonton).

At FjPi-29, there is a fair amount of variation in the soil profile. Excavation unit 22-11, one of the most productive archaeologically (see profile Figure 6), consisted of a black humus soil from surface to a depth of 30-40 cm below surface where a white volcanic ash became prevalent in a lens varying from a few to 10 cm in thickness. Below the ash

PROFILE OF THE POSTGLACIAL TERRACES OF THE NORTH SASKATCHEWAN RIVER IN THE VICINITY OF THE PARLIAMENT BUILDINGS AT EDMONTON.

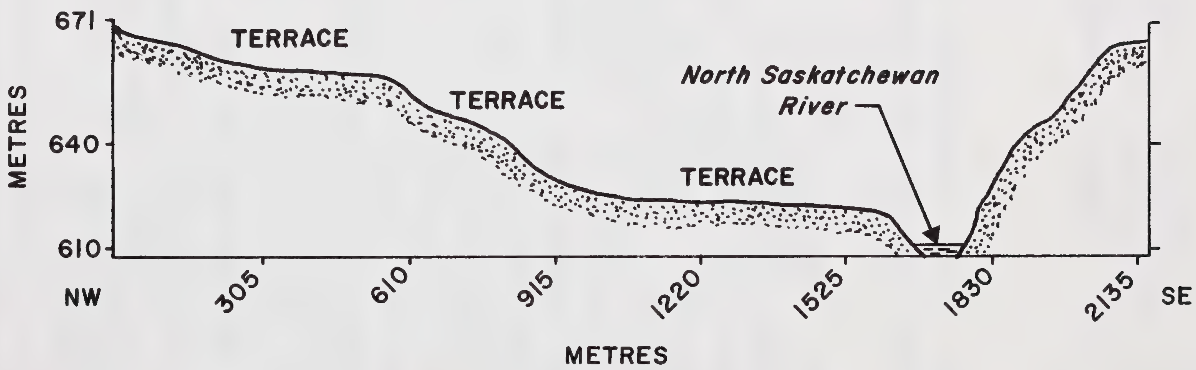


FIGURE 5: PROFILE OF THE POSTGLACIAL TERRACES OF THE NORTH SASKATCHEWAN RIVER IN THE VICINITY OF THE PARLIAMENT BUILDINGS. THE STRATHCONA SCIENCE PARK SITE (FjPi-29) IS LOCATED ON THE 671 METRE TERRACE WHICH FORMS THE VALLEY RIM (Adapted from Westgate, 1969:147).

a layer of compacted clay till is present.

Other units, such as 34-11 (see Figure 6), consisted primarily of a homogeneous grey-brown clay loam throughout the culture bearing strata.

Unit 35-22, located away from the valley rim also consisted of a uniform clay loam (Figure 7). This unit was unusual though, as the floor of the unit resting on compacted clay till exhibited considerable micro relief in that it demonstrated a gently rolling topography inherent in the glacially derived clay subsoil. In this particular unit the slope was from the southeast descending rapidly in a northwesterly direction with pitted inclusions up to 10 cm deep. None of these features are exhibited at the surface where a relatively flat ground surface exists. The depressions in the subsoil appear to be natural phenomena and not the result of human cultural activities.

Excavation unit 45-23 also exhibited no obvious stratigraphy (Figure 7). The cultural zone comprised a relatively homogeneous layer of clay loam.

Several lines of horizontal and vertical stratigraphic evidence can be used to argue the hypothetical single-component nature of the site, especially in levels below a 10 cm depth.

First, all of the morphologically diagnostic artifacts recovered from the excavated units would seem to relate to an Oxbow-like plains archaic artifact assemblage (Figure 12). Secondly, the only late prehistoric diagnostic material recovered (Figure 12) came from an area of shallow surface disturbance (Figure 3). Data gained from a controlled surface pickup, utilizing triangulation within 10 metre squares, also suggested that the late prehistoric materials may be scattered across the site in a discontinuous horizontal pattern. The deeper archaic materials are, however, present throughout the site area.

A third line of evidence is provided by utilizing data on the percentage frequency of lithic debitage raw material type by 10 cm level and unit within a sample universe consisting of ten 2x2 metre excavations. These data have been plotted on a triangular co-ordinate graph (Figure 9). The resulting tight clustering of data tends to indicate, in our

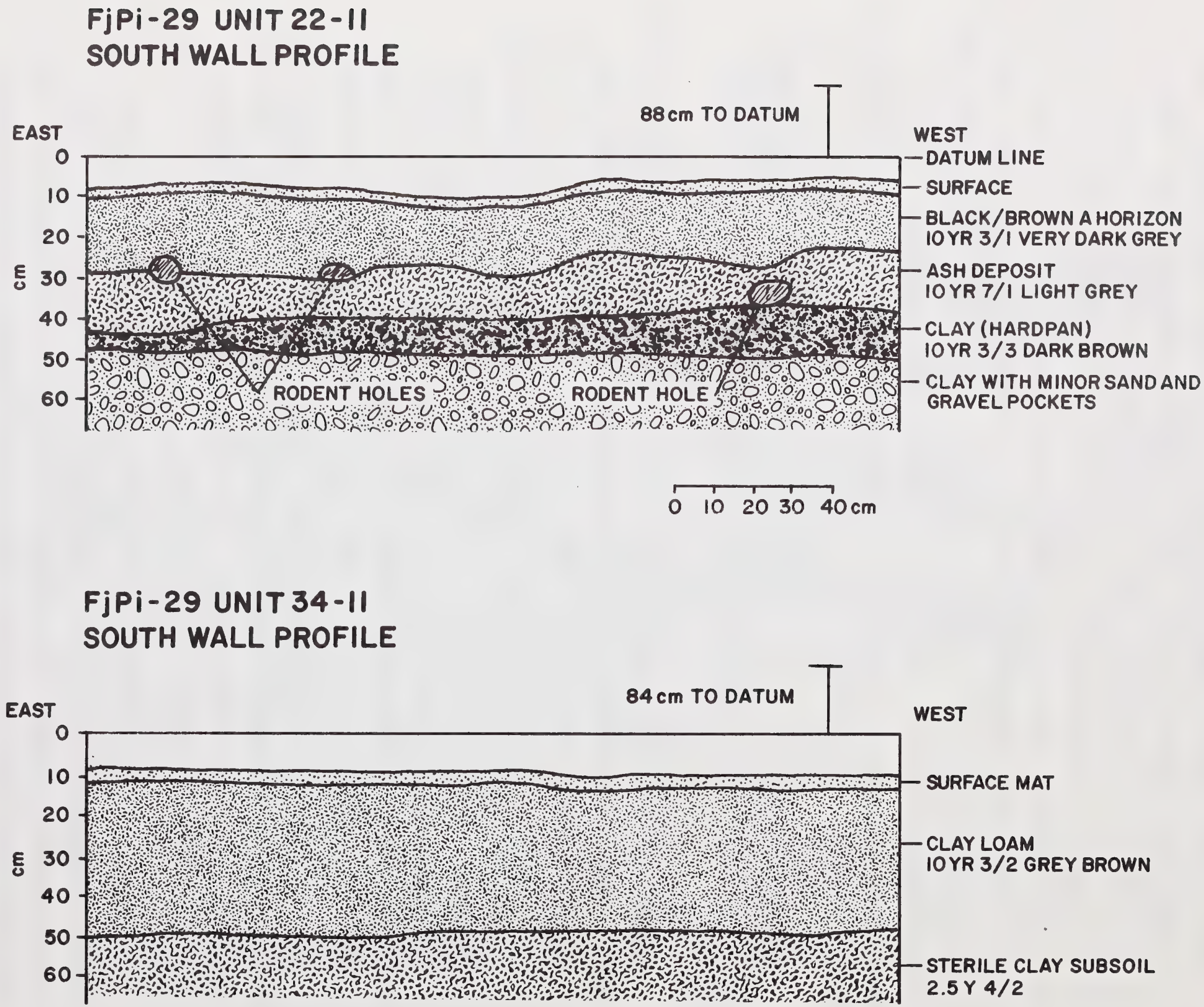


FIGURE 6: SOUTH WALL PROFILES OF UNITS 22-11 AND 34-11

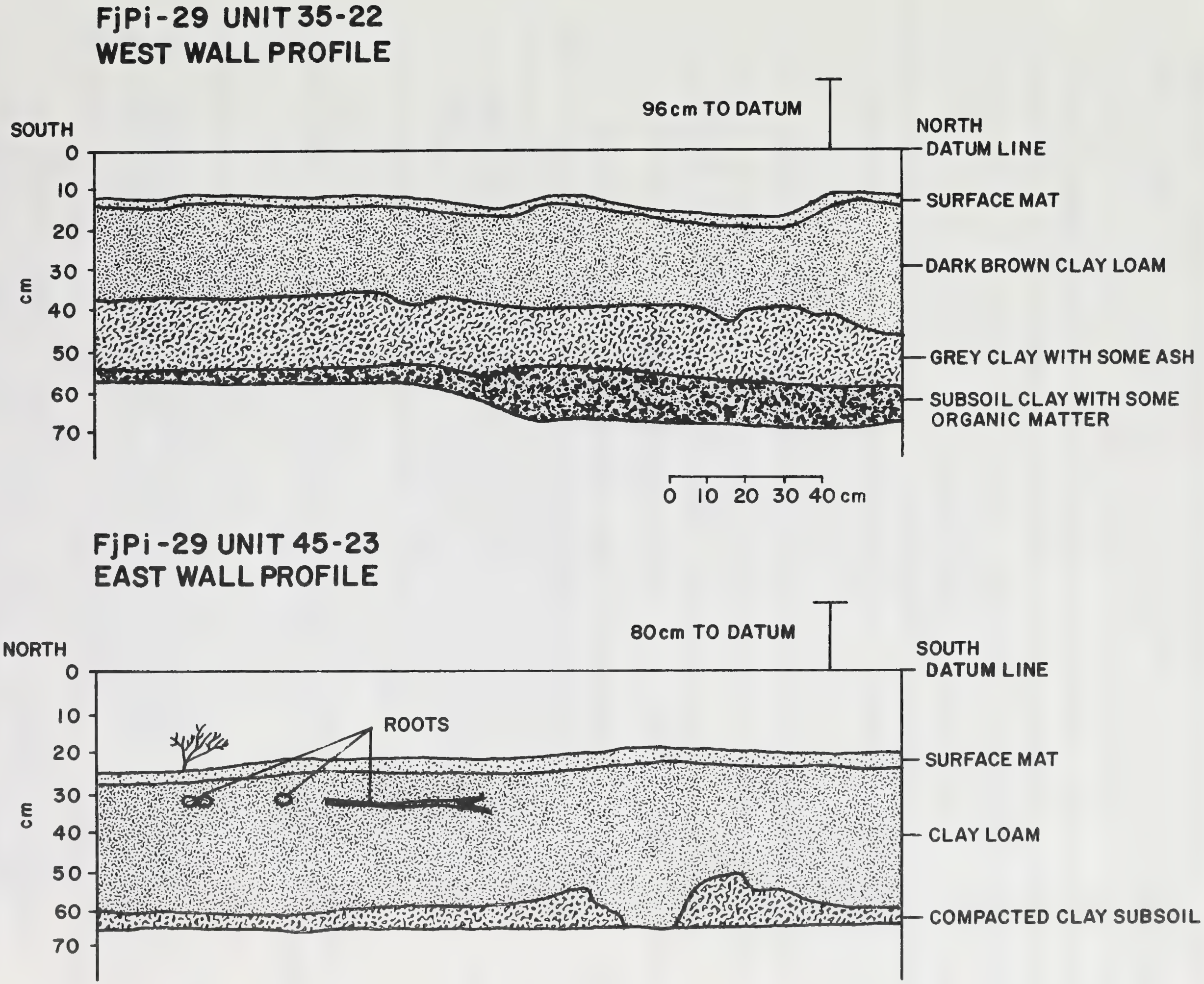


FIGURE 7: WEST WALL PROFILE OF UNIT 35-22 AND EAST WALL PROFILE OF UNIT 45-23.

opinion, a homology indicative of a single technological tradition. This analysis is developed at length in the following chapter of this paper.

A fourth and important line of evidence consists of radiocarbon dating results. Although there are a total of five samples from the site suitable for radiocarbon dating, to date results have only been received in regards to one sample. This particular sample (No. 5) was obtained from level four in excavation unit 37-10 at a depth of 30.0 cm below surface and at a depth of 119 cm below the arbitrary horizontal control datum for the site. The sample consisted of 233.79 grams of bone. Specifically, two bone elements were represented. One was the distal internal extremity facet of a left humerous of *Bison bison*. The other element represented consisted of fragments of the external side of a shaft of the left humerous of *Bison bison*. Although these specimens may have come from the same animal, the pieces do not meet (i.e. they could not be fitted together). The *Bison bison* identification is an absolute one with no possibility for alternative identification (personal communication: Dr. John Hillerud).

The sample was sent to Krueger Enterprises Inc., Geochron Laboratories Division. Geochron employed the following procedure:

> "The bone was cleaned of dirt and other observed contaminants. It was then crushed to -10 mesh and the crushed material was digested in cold, dilute acetic acid for 72 hours with frequent agitation and changes of acid, to remove normal carbonates. The remaining material, mostly bone apatite (hydroxyapatite), was washed clean and reacted with cold, dilute HCl, under vacuum, to release carbon dioxide from the bone apatite for the analysis" (Geochron:letter of February 28, 1979).

The resulting bone apatite gave a date of 2185 ± 190 C-14 years = 235 B.C. (GX-G276-A), C-13 corrected.

Following this, a second date from the same sample was obtained when:

> "The insoluble residue from the bone apatite dissolution procedure, including any collagen, was filtered and washed. It was then boiled in slightly acid distilled water to solubilize the collagen. This "broth" was filtered and the filtrate, containing the soluble collagen, was evaporated to dryness to recover the collagen as bone gelatin. Rootlets, humic acids, etc., should have remained insoluble and would have been removed by the filter. The recovered bone gelatin was combusted to carbon diozide and analyzed". (Geochron:Letter of February 28, 1979).

The resulting data from the bone gelatin fraction yielded a date of 2020 ± 105 C-14 years: 70 years B.C. (GX-6276-G), C-13 corrected.

Both the bone apatite date and the bone gelatin (Collagen) dates are reasonably concordant and suggest an age from the Bison bison bone sample of between 235 and 70 years B.C. This date, if correctly dating the archaeological materials, would indicate that a terminal plains archaic assemblage is present at the site. However, more than one sample is required to adequately date a site as large and complex as FjPi-29. A further four samples from the 1978 field season are to be analyzed in 1979, as well as any additional samples collected during the 1979 field season. It is possible that a lengthy plains archaic occupation is represented and that the above date represents a terminal stage of settlement rather than the initial habitation at the site.

ARTIFACT ANALYSIS, COMPARISONS AND SITE INTERPRETATIONS

PATTERNS OF RAW MATERIAL UTILIZATION

(a) Description of Utilized Raw Materials

White there was a diversified range of raw material utilized on the site, quartzite was by far the predominate raw material, accounting for 75% of the total excavated lithic sample. Petrified wood was a distant second in frequency, representing 15% of the sample. The remaining 10% was divided between various forms of chert, silicified sandstone, siltstone, aryillite, chalcedony, quartz and granite.

All of these raw materials were readily available locally either in Saskatchewan Sand and Gravel exposures or till deposits (MacPherson and Kathol, 1973), (Westgate 1969).

The quartzites were obtained in the form of cobbles of varying sizes but predominantly ovate in shape. Equally as varied was the quality of quartzite available, ranging from a very fine grained blue-gray variety through a range of medium to coarse grained varieties of various colours.

Similarily, petrified wood was also obtained in pebble to cobble sized pieces in a range of qualities. Petrified wood is characterized by "...poorly developed cleavage planes resulting in a tendency to fracture into thin flat sheets." primarily along the growth rings of the

original wood (Brumley, 1976:54). Because of these cleavage planes, petrified wood is a difficult and somewhat unreliable material to knapp. Despite this drawback, the material was still important to the site occupants as evidenced by the frequency with which it occurs in the test units.

The remaining raw materials occurred primarily in the form of small cobbles or pebbles which appear to have been used mainly in the bipolar reduction process.

Of interest is the origin of quartzite cobbles used by prehistoric tool makers at FjPi-29 in their lithic industry. The Edmonton area is underlain by flat lying cretaceous shales and sandstones of marine and freshwater origin, these formations cannot be the parent source for quartzite cobbles used by aboriginal peoples (Lang 1966:87). To the north lies the Precambrian Shield, largely composed of granite. It then also seems unlikely that quartzite cobbles were transported into Central Alberta by southward moving glaciers. However, to the west in the Rocky Mountains are massive formations of sedimentary rocks chiefly limestone, quartzite and shale (Lang 1966:86).

Available evidence, indicates that the quartzite cobbles used by aboriginal knappers in Central Alberta are derived from the main ranges of the Rocky Mountains to the west (Prest 1970:692, Babcock et.al. 1977:277). These quartzite cobbles or "clasts" are contained in the controversial, preglacial, Saskatchewan Sands and Gravels as described below:

> "These buried gravels are recognized in Alberta, Saskatchewan and Manitoba, occurring as alluvial terraces and benches below the Tertiary (Miocene-Pliocene) (See Figure One) pediment surfaces and as lower-level channels or valley fills. They are very extensive beneath the drift mantle whether this be a few feet or more than 1,000 feet thick; generally they are a few feet to a few tens of feet thick, varying laterally from sand to sand mixed with coarse grave...Westgate (1965) found that 98 percent of the gravel-sized material in southeastern Alberta is made up of quartzite, argillite and chert..." (Prest 1970:692).

There is a disagreement over the age of these gravels with a range of early to late Pleistocene suggested (Prest 1970:692).

Near Edmonton the saskatchewan sands and gravels characteristically

are found in the bottom of preglacial valleys (Prest 1970:692). Alternatively they can also be found in other situations such as at a gravel pit near Edmonton where the "preglacial sands and gravels lie on sandstones and shales of the Cretaceous Wapiti Formation...overlaid by massive clayey till about 4 m thick (Babcock et.al. 1977:277). In summary, it seems that the major source for Central Alberta quartzite industries are cobbles originating between thirteen and two million years ago in the Rocky Mountains and transported throughout the Canadian Plains area by river and stream action. Subsequent glaciation has alternatively buried these beneath till, or exposed them during post glacial erosion and valley downcutting where such phenomena overlaps with preglacial valleys and deposits. Of importance is the probability that sources for such cobbles are not uniformably distributed across the area. Thus the surficial geography by dictating the availability of suitable quartzite cobbles has strong archaeological implications for prehistoric settlement patterns and the location of lithic workshop sites.

(b) Raw Material Frequency and Intra-Site Variability

In the absence of diagnostic artifacts in seven of the ten excavated units, an alternative method of demonstrating technological and presumably temporal homogeneity between units had to be employed. As the raw materials used in prehistoric lithic industries often show shifts in frequency if not in kind through time, the raw material frequencies in each of the excavated units were calculated both by arbitrary level and total unit sample. At the unit level a similarity matrix based on the Brainerd-Robinson coefficient of similarity was compiled as a means of demonstrating the degree of similarity between units in terms of raw material frequencies. This technique was originally developed by Robinson on the premise that:

> "...over the course of time pottery types come into and go out of general use by a given group of people." (Doran and Hodson, 1975:272).

The similarity measure or "Index of Agreement" was determined by computing;

> "...the sum of the difference between the percentages for each type summed over all types (without regard to sign), subtracted from the maximum figure, 200..."(Doran and Hodson, 1975:273).

TABLE 1: COEFFICIENT OF SIMILARITY - ALL UNITS

	22-11	25-10	28-11	31-10	34-11	37-10	35-22	36-24	45-23	46-28
22-11	X									
25-10	176.13	X								
28-11	188.29	184.12	X							
31-10	183.57	183.02	185.86	X						
34-11	182.51	188.66	187.30	190.10	X					
37-10	183.51	185.04	189.06	189.22	188.78	X				
35-22	170.17	169.16	181.28	177.06	172.50	175.14	X			
36-24	172.87	186.36	175.40	176.50	183.12	178.36	160.00	X		
45-23	167.94	175.17	162.75	165.11	168.55	164.83	147.05	166.09	X	
46-28	176.36	186.25	172.77	181.17	184.47	177.67	159.17	184.07	172.62	X

Although originally developed as a means of seriating sites based on percentage differences in pottery types, the basic technique can theoretically be applied to any quantifiable set of "types", in this case raw material types, to demonstrate the degree of relationship between sites or, as here, excavated units.

Table 1 presents the matrix of Robinson similarity scores between the excavated units. This matrix was computed as outlined above, on the basis of differences in frequency of the following raw material types between units; quartzite, petrified wood, chert, chalcedony, siltstone, silicified sandstone, argillite, quartz and miscellaneous.

To clarify the interrelationship between units, as displayed in the similarity matrix, a dendrogram was compiled using single linkage, or nearest neighbour cluster analysis based on the relationships established in the matrix (Hodson and Doran 1975:175-176). In cluster analysis:

> "...the procedures start from a matrix of similarities of distances, like a mileage chart, recording relationships between each pair of units. This is repeatedly scanned during the procedure and units 'similar' to existing cluster members are successively joined to them, until all units and clusters have fused into one. This kind of structure may be exactly represented by a tree or dendrogram." (1975:175).

In single-linkage cluster analysis:

> "...at each successive stage of the hierarchy, a search is made for the closest pair of previously unlinked units, and a fusion is made between them. If the units are already included in clusters, the clusters fuse." (1975-176).

Figure 8 presents the dendrogram formed by the excavated units joined at the highest coefficient of similarity for each unit. The overall degree of similarity between units indicates that there is no significant degree of difference in raw material utilization between units, a homogeneity suggesting a single component site. On a specific level, the dendrogram can be separated into two closely related clusters, cluster one consisting of units 31-10, 34-11, 37-10, 28-11, 25-10 and 22-11, and cluster two which includes units 36-24, 46-28, 35-22 and 45-23. The two clusters reflect the location of their constituent units on the site,

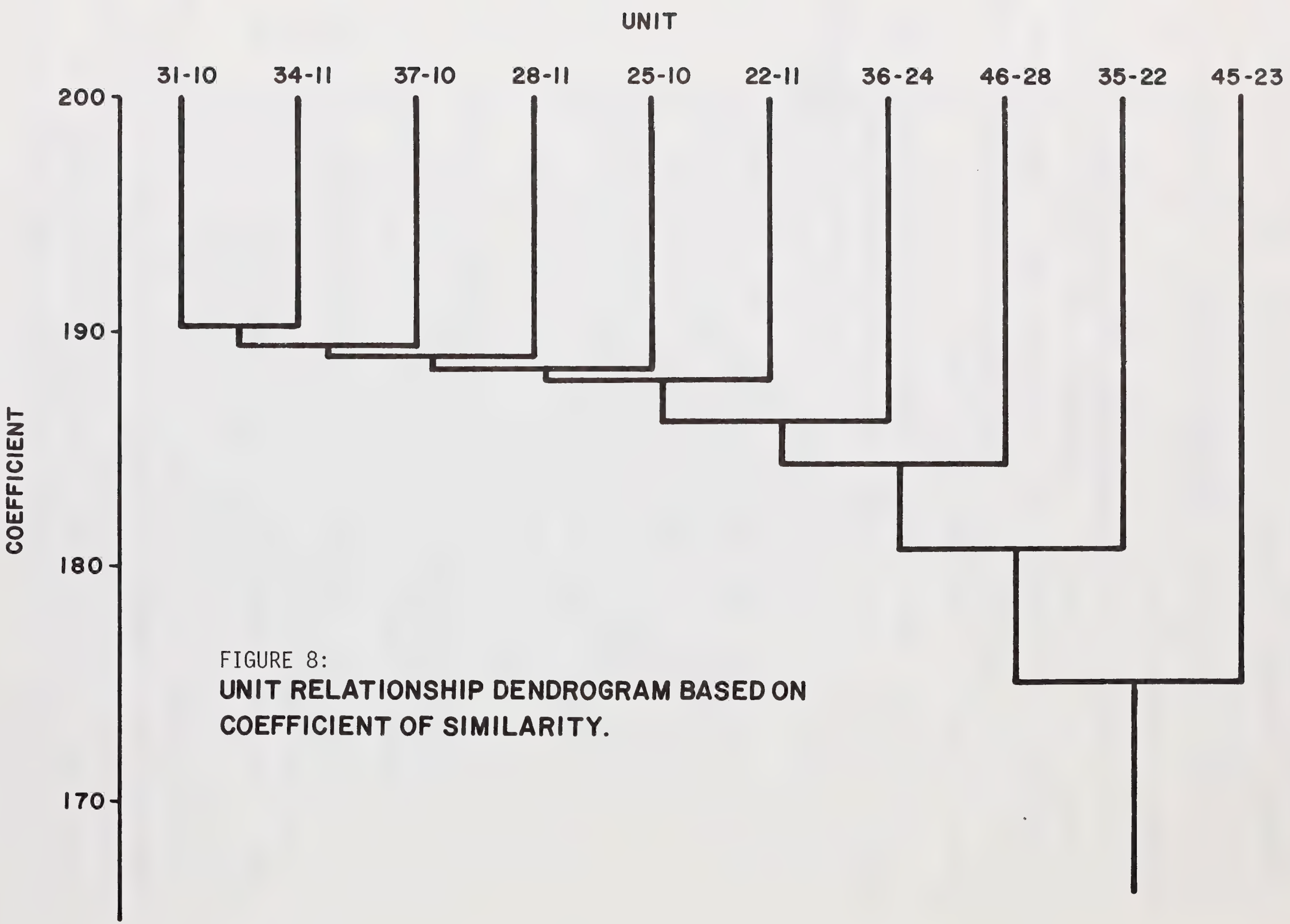


FIGURE 8:
UNIT RELATIONSHIP DENDROGRAM BASED ON COEFFICIENT OF SIMILARITY.

the first group being composed of units located on line A along the ravine while the second cluster consists of units located on lines 1 and 2 towards the centre of the site area (Figure 3). This clustering is largely the result of a slightly higher incidence of petrified wood in the units which comprise cluster two, possibly indicating two separate but related activity areas on the site.

To further confirm this pattern of raw material utilization, the percentage frequency of three categories of raw material, quartzite and petrified wood, the two major raw materials on the site, and a miscellaneous category incorporating the other lithic types, was calculated by arbitrary level for each of the ten units. Each unit-level was then located on a triangular coordinate graph, Figure 9. The tight clustering of the unit-levels on the graph as mentioned previously, confirms the overall homogeneity of raw material utilization between units, suggestive of a single component occupation of the main site area. The higher incidence of petrified wood noted for cluster two on the similarity dendrogram is again apparent, particularily for unit 45-23. Again, this is probably indicative of slight variability in raw material utilization in a specific activity area.

PROJECTILE POINTS

A total of six projectile points and point fragments were collected from the site, representing two distinct morphological groupings. The first and latest group was comprised of two late prehistoric side-notched points, pressure flaked on chert flake blanks. The second and most predominant group consisted of four basally thinned Plains Archaic points with weak side notching manufactured from quartzite flakes (Dyck 1977:72), Frison 1978:45,83 Figure 2.26).

(a) <u>Late Prehistoric Side-notched (Figure 12, F,G).</u>

Two poorly made chert points were surface collected from the partially disturbed area at the eastern edge of the site. The largest of the two specimens consists of the basal portion of a point, the tip, one lateral edge including the notch and most of one face having been removed by thermal fracturing. The point had pronounced basal thinning but showed no indication of grinding either basally or in the notch. The second and smaller of the two specimens was a complete point manufactured on a

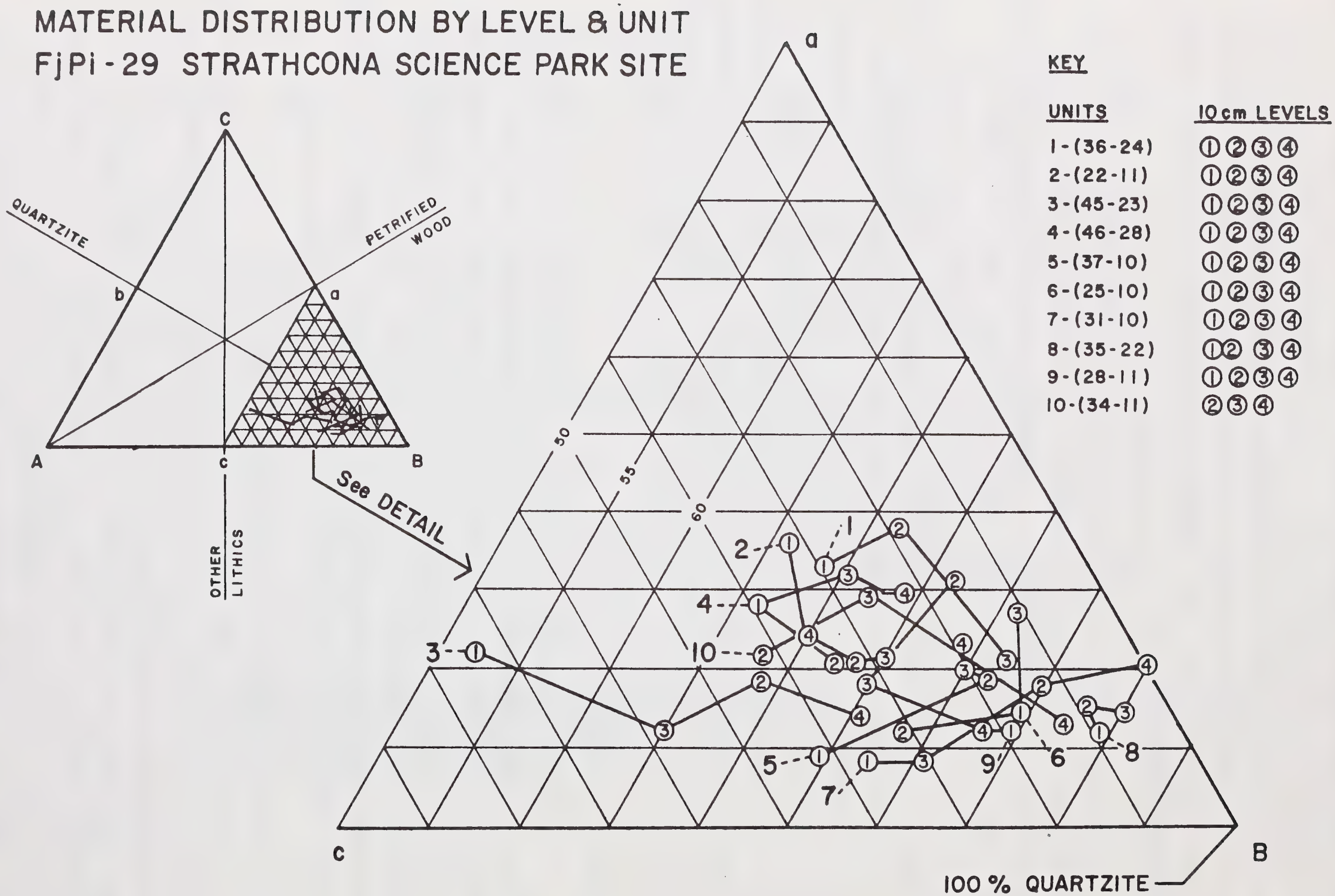


Figure 9: Lithic raw material distribution at FjPi-29, plotted on a triangular graph.

dull dark gray-black opaque chert flake. The point was laterally and basally retouched, with incomplete bifacial flake scars. There was no indication of grinding on the base or in the notches nor any attempt at basal thinning. Complete metrics and morphology for the two points are presented in Table 2.

(b) Plains Archaic, Basally Thinned Side-Notched (Figure 12, A,B,C,E).

The remaining four points and point fragments were manufactured from a very fine grained gray-blue to gray-brown quartzite. The sample consists of two basal sections, one complete specimen and one point "ear". The breakage pattern on the points is similar to that noted by Dyck at the Harder Site (1977:77). Two of the points were snapped transversely at or near the middle of the point, one point was missing an "ear" and the ear from a third point was also recovered. The remaining lateral edge sections of the two transversely broken points show little or no indication of edge attrition through use-wear. One of the points had pronounced grinding on the ears and in the basal concavity, while the other point was only lightly ground in these areas. Assuming that basal grinding would have represented one of the final steps if not the last step in point manufacture, the presence of grinding on both points taken in conjunction with the condition of the lateral edges of the point blades suggests breakage through use almost immediately after completion of the points. Similarly the pattern of ear fracture suggests breakage during use of the point. The recovered ear fragment was heavily ground as was the remaining ear on the previously mentioned point base suggesting that the points had been finished when breakage occurred.

Of the three analyzable points, side notching was present on only two specimens, and in both cases the notches were very shallow. The third specimen was slightly "waisted" or constricted above the basal indentation, rather than notched. All three points were basally thinned bifacially, as was the case with the Harder site points, producing a basal indentation, or bifurcation, which varied in depth. A complete metric and morphological description of the points is presented in Table 2.

(c) Distribution

As mentioned previously, the two chert side-notched points and one of

TABLE 2: PROJECTILE POINT, HAFTED BIFACE METRICS AND MORPHOLOGY

Catalogue Number	Unit/ Level	Raw Material Type and Artifact Condition	Lateral Edge Shape	Basal Thinning	Basal Grinding	Lateral Grinding	Metrics (mm)							Inter North Breadth	Basal Convavity Depth
							Length	Breadth	Thickness	North Breadth Left	North Breadth Right	North Depth Left	North Depth Right		
2452 Plains-Archak similar to Oxbow	Surface	Fine grained Gray/brown semi-trans-lucent Quartzite-Broken Distally-Basal 1/2	-	+	Slight	Slight Bi-lateral and in notch	*22.0mm remain-ing length	20.5mm	5.5mm	4.5	-	1.5	-	17.5mm	4.5mm
3127 Plains-Archak similar to Oxbow	37-10 Level 4 (34.0 cm B.S.)	Fine grained Gray-blue Opaque Quartzite Right ear missing	Markedly Convex with Basal constric-tion	+	-	-	34.5	18.0	5.5mm	-	-	-	-	14.0	2.30
3240 Plains-Archak similar to Oxbow	36-24 Level 3 (27.0 cm B.S.)	Fine grained Gray-blue Quartzite Semi-trans-lucent Laterally Broken-Distally Ear missing	Convex	+	-	Moderate on ear and notch	37.2 re-maining length	24.4	5.5mm	9.0	-	1.30	-	-	10.0
1157 (Plains Archak similar to Oxbow	22-11 Level 2 (10-20 cm B.S.)	Fine grained Gray-brown Semi-trans-lucent Quartzite Basal Fragment	-	-	-	-	-	-	-	-	-	-	-	-	-
2866 Halfted Biface	31-10 Level 4 (35.0 cm B.S.)	Opaque white coarse Quartz	Convex	+	-	-	48.5	37.5	10.5	11.0	-	4.5	-	21.8	Straight
610 Late Pre-Historic Similar to Prairie Side-Notched	Surface	Dark brown Chert semi-translucent along edges. Thermally fractured resulting in removal of tip and one face of the point	Straight	+	-	-	20.20 re-maining length	-	4.0	7.5	-	2.70	-	14.30	Straight
Late Pre-Historic Similar to Prairie Side-Notched	Surface	Dull black Chert Point Pressure Flaked from Flake	Straight	-	Retouched	-	16.5	13.0	3.5	4.0	3.0	1.5	1.0	9.90	Straight

the quartzite points were collected from the surface of the partially disturbed eastern edge of the site. The remaining three points, however, were excavated "in situ" from three separate units. As previously explained, the cultural deposit at the site consisted for the most part of some 40-50 cm of homogeneous clay loam with no natural stratigraphy, therefore the site was excavated in arbitrary 10 cm levels. Projectile points or point fragments, were recovered from three different levels in three units, a factor which greatly facilitated the interpretation of site occupation. The basal or "ear" fragment was recovered from unit 22-11, level 2 (10-20 cm below surface), a basal fragment was recovered at a depth of 27.0 cm below surface in level 3 (20-30 cm) of unit 36-24 while the complete point came from level 4 of unit 37-10 at depth of 34.0 cm below surface. In effect then, levels 2, 3, 4 and 5, from 10 to 50 cm below surface can be attributed to the Plains Archaic occupation of the site. The top ten centimetres of deposit were disturbed, containing both intrusive historical debris as well as late prehistoric material. On the basis of the projectile point distribution, taken in conjunction with other artifact categories found in association with them, the site as presently defined has been interpreted as representing a single component occupation.

(d) Inter-Site Comparisons

Typologically, the Oxbow projectile point has been described as,

> "...side-notched with notches straddling the widest part of the blade, and basally thinned with thinning flakes extending on both faces up to or slightly beyond a line joining the distal juncture of the notches. Thinning usually produces a pronounced basal concavity." (Dyck 1977:6).

Dyck notes however, that at the Long Creek site in addition to the traditional Oxbow point, unnotched basally thinned projectile points were also recovered (1977:6). On the basis of projectile point typology, Dyck has assigned the Harder site to the Oxbow complex (1977:5). The quartzite basally thinned projectile points from FjPi-29 are by no means typical of the classic Oxbow projectile point, however, they do fit the description as given above. Morphologically, the points compare favourably with some of the points illustrated by Dyck from the Harder Site (1977:309, Plate 17 1,0 U). Metrically the points fall well within the

range of variation given for the Harder site points. The major discrepancy between the Harder site and FjPi-29 is in the raw materials selected for point manufacture. The majority of the Harder site points are manufactured from cherts and chalcedony (63%), with petrified wood second (19%), followed by silicified shales and limestone. Only two of the 63 complete or fragmented finished points were manufactured from quartzite. However, as quartzite is the predominant raw material at FjPi-29, this difference between sites may reflect the local availability of raw materials rather than major cultural or temporal differences.

BIFACES AND UNIFACES (Figures 13-15)

The two basic classes of biface defined by Morlan "...on the basis of the technological procedures involved..." in their manufacture, form the basis for the analysis of the bifaces from FjPi-29. These two classes include Rough Bifaces which

> "...appear to be unfished specimens or roughed-out preforms in that facial flaking may not be completed, and marginal retouch may be incomplete or absent..."

and Finished Bifaces which are

> "...recognized by their more regular, symmetrical appearance, complete facial flaking, and fine marginal retouch..." (Morlan 1973:27-29).

(a) Raw Material Utilization

Of the twenty-six complete and fragmentary bifaces and unifaces recovered from the excavation units, the majority (19-73.08%) were manufactured from quartzite, a trend repeated in almost all of the artifact categories from the site. Quartz was a distant second in frequency (4-15.38%), followed by petrified wood (2-7.69%) and a single biface manufactured from an unidentified material (3.85%).

(b) Distribution

Biface-uniface distribution was determined both by unit and by arbitrary ten centimetre level. Units 22-11 and 46-28 produced the highest frequency of bifaces of all of the excavated units (7-26.92%) (5-19.23%), a trend which combined with the high frequency of other artifact categories from these units suggests that the units may represent important areas of

TABLE 3: BIFACE-UNIFACE DISTRIBUTION AND RAW MATERIAL UTILIZATION BY UNIT

Unit	Raw Material								Total	
	Quartzite		Petrified Wood		Quartz		Miscellaneous			
22-11	6	85.71	1	14.29 50.0	-		-		7	100 26.92
25-10	3	100 15.79	-		-		-		3	100 11.54
28-11	3	100 15.79	-		-		-		3	100 11.54
31-10	-		-		*1	100 25.0	-		1	100 3.85
34-11	-		-		1	100 25.0	-		1	100 3.85
37-10	1	50.0 5.26	-		1	50.0 25.0	-		2	100 7.69
35.22	-		-		-		-		-	
36-24	1	100 5.26	-		-		-		1	100 3.85
45-23	2	66.67 10.53	1	33.33 50.0	-		-		3	100 11.54
46-28	3	60.0 15.79	-		1	20.0 25.0	1	200 100	5	100 19.23
Total	19	100 73.08	2	100 7.69	4	100 15.38	1	100 3.85	26	100 100

*Hafted biface (Figure 12-d)

TABLE 4: BIFACE-UNIFACE DISTRIBUTION AND RAW MATERIAL UTILIZATION BY ARBITRARY LEVEL

Level	Raw Material								Total	
	Quartzite		Petrified Wood		Quartz		Miscellaneous			
1	-		-		-		-		-	
2	5	100 26.32	-		-		-		5	100 19.23
3	5	50.0 26.32	2	20.0 100	2	20.0 50.0	1	10.0 10.0	10	100 38.46
4	8	80.0 42.11	-		2*	20.0 50.0	-		10	100 38.46
5	1	100 5.26	-		-		-		1	100 3.85
Total	19	100 73.08	2	100 7.69	4	100 15.38	1	100 3.85	26	100 100

* Hafted biface (Figure 12 -d)

lithic reduction on the site. The rest of the biface-uniface sample was fairly evenly distributed between the other units with the exception of unit 35-22 which was barren of bifaces (Table 3). Similarly, the biface distribution by arbitrary level follows a recurring pattern, repeated in the other artifact groupings from the site. The majority of the biface-uniface sample was recovered from levels 3 (10-38.46%) and 4 (10-38.46%) followed by level 2 (5-19.23%). The single remaining biface came from level 5 (Table 4).

(c) Metrics and Morphology

The artifacts comprising the sample were found to be in various stages of reduction, including specimens which were completely flaked bifacially, examples of incomplete bifacial flaking in which various amounts of cobble cortex still adhered to the dorsal face of the artifacts and artifacts which were either completely or partially flaked unifacially. It is suggested that this range of flake removal with certain exceptions, represents stages in a biface manufacturing process which will be discussed further. Table 5 presents the metrics and morphology of the more complete specimens from the site, recovered both from the site surface and the excavation units. From Table 5, it is apparent that most of the bifaces and unifaces analyzed had at some point in their production stage either, developed a flaw such as a major step or hinge fracture which potentially prevented further reduction, or snapped transversely either as the result of a mistake in percussion or a material flaw again terminating the reduction process.

(d) Reduction Model

As demonstrated in Table 3, the biface-uniface industry of FjPi-29 was based primarily on quartzite reduction. Quartzite was readily available from local deposits in the form of cobbles of varying sizes, which had to be split into usable sections for incorporation into the reduction process. Quartzite cobbles are noted for their resiliency, hardness and densely packed silica cortex or "rind", characteristics which tend to complicate the splitting of the cobbles into usable fragments. From the frequency with which quartzite cobble fragments appear at FjPi-29, and a host of other prehistoric sites, it is obvious that the prehistoric

TABLE 5: BIFACE/UNIFACE METRICS AND MORPHOLOGY

Raw Material Type-Catalogue Number	Texture	Source		Flaking Tech.		Reason for Discard				Description	Maximum (cm)			
		Cobble Spall	Other	Biface	Uniface	Hinge	Step	Break	Flaw		L	B	T	T/B
Quartzite (1006)	Medium	X		X		X	Extreme			Biface	14.65	7.81	2.94	.38
Quartzite (682)	Medium	X		X		X			X	Preform	7.62	5.58	1.96	.36
Quartzite (578)	Medium	X		X			Extreme		X	Preform	8.90	7.91	2.40	.30
Quartzite (1005)	Medium	X		X			Extreme	X		Biface		8.26	2.10	.25
Quartzite (518)	Medium	X		X		X	Extreme			Preform	10.72	5.79	1.94	.34
Quartzite (2027)	Coarse Coarse	X X		X		X	Extreme			Preform	10.52	8.0	2.52	.32
Quartzite (3755)	Medium	X		X			X	X		Biface		5.02	1.36	.27
Quartzite (1435)	Fine	X		X			X	X		Biface		6.20	1.71	.28
Quartzite (1400)	Medium	X		X			Extreme			Preform	8.78	6.86	2.15	.31
Quartzite (1869)	Medium	X		X			Extreme			Preform-steep lateral edge and proximal end	9.22	7.02	2.69	.38
Quartzite (3500)	Medium-fine	X			X		Extreme			Uniface-possibly perform for biface-unfinished	7.85	5.97	2.47	.41
Quartzite (2453)	Medium		Split Cobble	X		X	Extreme			Preform-edge too steep for further reduction	6.67	6.05	2.94	.49
*Quartzite (595)	Medium	X		X		X				Biface-very good possible specialized tool	*5.00	3.76	1.82	.48
Quartzite (594)	Medium-fine		Split Cobble		X		X			Uniface-steep lateral edges	8.54	4.81	2.31	.48
*Quartzite (613)	Fine		Split Pebble		X		X			Preform-possibly scrapper-plane	*4.58	3.74	1.71	.46
Surface	Medium	X		X			Extreme			Preform Cobble con-tex-edge too steep	9.43	7.65	2.15	.28
Surface	Coarse	X		X					X	Biface	9.67	6.10	1.53	.25
Surface	Coarse	X	Split Cobble	X			X			Biface-cortex unable to remove central cortex	11.27	4.77	1.64	.34
Surface	Coarse			X			X	X		Preform cobble cortex	8.93	6.24	2.23	.36
Surface	Medium-fine		Split Cobble	X					X	Preform lateral edge too steep to reduce	8.94	5.62	2.24	.40
Surface	Medium	Prob.		X				X		Preform-no cortex	117.70		1.78	
*Surface	Medium		Flake	X						Biface on flake block	*7.25	3.95	.89	.23

* Remaining Dimensions

knappers had learned to efficiently contend with this problem. The question remains, how did they do this?

Bucy notes that while lithic materials are generally best worked at moderate temperatures;

> "Under certain conditions, however, low temperature of materials may be put to the worker's advantage, for example, the splitting of large boulders or the removal of large spalls from cobbles or boulders of such tough materials as basalt or quartzite." (Bucy 1971:24).

Bucy, cites ethnographic evidence of the Nez Perce removing spalls from large cobbles along the Clearwater River, an activity usually conducted in the winter (1971:24).

Recent replicative experimentation by the authors with methods of fracturing quartzite cobbles has led to the development of several potentially viable techniques. Bonnichsen, in his film on cobble reduction, was able to split a quartzite cobble into fragments (at the risk of life and limb), simply by hurling the cobble at another cobble-anvil positioned on the ground. A second and much more efficient technique for splitting cobbles, involves burying a flat anvilstone with a cobble placed on top of it, such that the tip of the cobble protrudes above ground. It was found that when the tip of the cobble was struck by an impactor dropped from directly above it, the cobble was fractured into several spalls, which were prevented from flying apart by the surrounding earth and thus easily retrieved. The packed earth surrounding the cobble appears to contain the force waves from the impact inside the cobble causing it to fracture and even driving off flakes from areas not directly impacted by the percussor (Dr. A. Bryan, personal communication). While all of these are viable methods of cobble reduction the former should be tested experimentally, while the latter, especially the buried anvil technique, remains to be demonstrated archaeologically.

Table 6 is a lithic reduction-manufacture model for FjPi-29, based in part on the cobble technology reconstructed from lithic debris collected from the site. The model assumes that cobbles were collected from sources both on site but primarily off-site, in which case they were split and selected pieces then transported back to the site for

further reduction. The use of spalls, and to a lesser extent cobble halves, for biface manufacture as suggested in the model is supported by the presence of a series of spalls in the artifact assemblage from the site which represented various stages of reduction to the finished biface preform (Figure 16). None of the bifaces from the site were at Morlan's "Finished Biface" stage of manufacture. This could be construed as either sampling error, or typical of a quarry-workshop situation where biface blanks or preforms were prepared on the site and then transported elsewhere for final flaking (Losey 1974:86-87). The quantity and type of lithic debris and finished artifacts recovered from the test units, tends to support the interpretation that the site functioned primarily as a workshop. However, the depth of the site and the presence of sizeable quantities of faunal material in the excavated units suggests that the site was also an important habitation area. Only further excavation can resolve these problems.

(e) Inter-Site Comparison

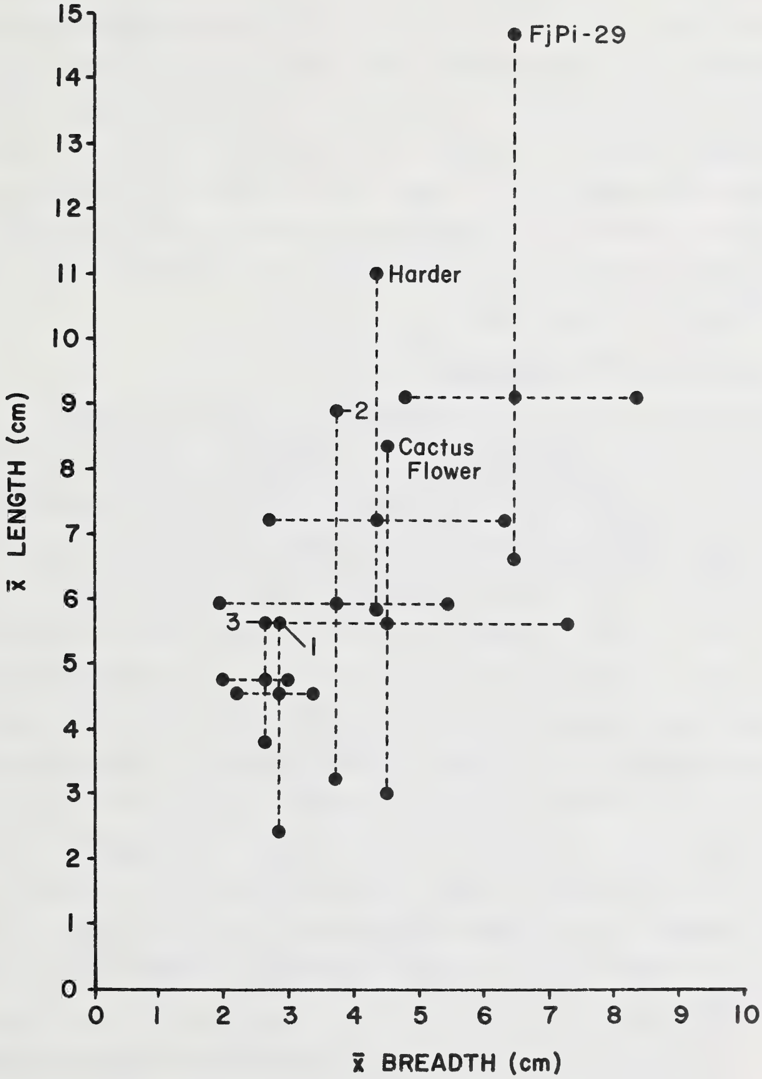
Table 7 presents a comparison of the mean metrics and metric range of the bifaces from FjPi-29 with bifaces from the Harder site and Cactus Flower site (Dyck 1977:133), (Brumley 1975:118, Table 8). Brumley, divided his biface sample into four classes based on shape and degree of bifacial flaking. For comparative purposes, only two of his four classes are included in Table 7, Class 1, Pointed Bifaces, which comprised the smallest of his four classes metrically, and Class 2, Ovate to Rectanguloid Bifaces which were the largest bifaces metrically. From Table 7, it is apparent that the bifaces from FjPi-29 are larger than those from both Harder and Cactus Flower. Similarly, the Harder site bifaces are noticeably larger than the bifaces from Cactus Flower (Figure 10). This size discrepancy between sites is undoubtedly a reflection in part of the difference in raw materials used in biface manufacture on the three sites. It is tempting however to attribute this difference to site function as well. Both Harder and Cactus Flower have been interpreted as representing seasonally occupied hunting camps, whereas FjPi-29 appears to have functioned primarily as a workshop site for the production of preforms.

TABLE 6: LITHIC REDUCTION MODEL

Associated Tools	Processes
	Cobble Selection
	Off-site(1) On-site(2)
Hard Hammer and Possibly Anvilstone	Initial Splitting and Selection
	Transportation to Site
Hard and Possibly Soft Hammer	Initial Reduction and Final Selection of Suitable Spalls (A) and Cobble Core (B)
(A) Soft Hammer (B) Hard Hammer	Initial Manufacturing Process
	(A) Direct Percussion of Spalls and Cobble Halves into Biface Preforms (Blanks) or Unifaces; (B) Removal of flakes from cores → Core exhaustion and discard, possible secondary utilization for tool production
	Discard of broken blanks and blanks not amenable to further reduction into refined bifaces. (possible "as is" utilization); Selection of flakes for further refinement
	Utilized flakes, scrapers or flakes, biface and point preform
Soft Hammer Pressure Retouch	Refined biface; Finished points

TABLE 7: BIFACE-COMPARATIVE DATA, FjPi-29, HARDER, CACTUS FLOWER

SITE	NUMBER	MEAN LENGTH	MEAN BREADTH	MEAN THICKNESS	MEAN LENGTH	MEAN BREADTH	MEAN THICKNESS	RAW MATERIALS
FjPi-29	19	8.96	X	X	14.65 -4.58	X	X	
All Bifaces	21	X	6.05	X	X	8.26 -3.74	X	Quartzite
	22	X	X	2.07	X	X	2.94 -.89	
Large Bifaces	16	9.59	X	X	14.65 -6.67	X	X	
& Preforms	18	X	6.43	X	X	8.26 -4.77	X	Quartzite
	19	X	X	2.25	X	X	2.94 -1.64	
Harder	4	7.22	X	X	11.0 -5.8	X	X	Limestone
	5	X	4.32	X	X	6.3-2.7	X	Petrified Wood
	6	X	X	1.25	X	X	1.7-0.6	Chert
Cactus Flower	4	4.52	X	X	5.68 -2.76	X	X	Chert-8
Pointed Biface	6	X	2.86	X	X	2.23 -3.35	X	Petrified Wood - 1
	6	X	X	.92	X	X	1.19-0.63	
Ovate to Rectanguloid	14	5.96	X	X	-3.23 8.96	X	X	Chert - 11
Bifaces (2)	14	X	3.74	X	X	-1.99 5.47	X	Quartzite - 2
	14	X	X	1.59	X	X	-.86 2.60	Petrified Wood - 1



MEAN LENGTH - BREADTH COMPARATIVE SCATTERGRAM. BIFACES FROM HARDER, CACTUS FLOWER & FjPi-29.

FIGURE 10

SCRAPERS

Perhaps one of the more interesting aspects of the site is the fact that only eight scrapers were recovered, one from the surface of the disturbed area, the remaining seven from the excavation units. Losey, in his analysis of the material from the Stony Plain Quarry site, did not find any scrapers only retouched flakes, while a total of only twenty-three scrapers were recovered from the Beaver Creek Quarry site, fifteen of these being retouched side and flake scrapers, the remaining eight end scrapers (Losey 1971:138-149), (Losey et.al. 1974:100-103). Of the eight scrapers from FjPi-29, three were end scrapers and the remaining five retouched flake scrapers.

(a) Raw Material Utilization

Considering the fact that quartzite was by far the most prevalent raw material on the site, the scraper sample is interesting in that quartzite was used in the manufacture of only two of the eight specimens. Of the remaining six artifacts, two were manufactured from siltstone, two from argillite, one from chert and one from petrified wood (Table 8). Both of the argillite scrapers and one of the siltstone scrapers display cortex, and in addition, the siltstone scraper was manufactured on a split pebble. The majority of the cherts, siltstones and argillites from the site were in the form of pebbles which for the most part had been split in a bipolar fashion. Forsman, in his analysis of the artifacts from a site on Montreal Lake in central Saskatchewan, noted that bipolar technology was the most common method of core reduction. Forsman suggested that in some cases wedges as well as other types of bipolar forms "...served as blanks for further modifications into artifacts," noting that;

> "An analysis of all the artifacts from the Montreal Lake area indicated that a significant proportion of the artifacts were worked by the modification of blanks which were formed by the bipolar technique." (Forsman 1976:19-20).

In light of Forsman's findings taken in conjunction with evidence of the bipolar reduction of chert, petrified wood, and other types of cobbles and pebbles at FjPi-29, it would seem probable that the range of raw

materials other than quartzite used in scraper manufacture is a reflection of a selective process. A process which in part uses "blanks" derived from the bipolar splitting of smaller more exotic pebbles for tool production.

(b) Metrics and Morphology

The metrics and morphology of the scraper sample has been summarized in Table 8. Three of the five flake scrapers manufactured from siltstone (2) (Figure 17, D,F) or argillite (1) (Figure 17 A) were found to have a working edge angle of less than 50^{0} while the two quartzite flake scrapers have edge angles of 60 to 63^{0} respectively (Figure 17 E,G). While not readily demonstrable, there may be a correlation between the hardness hence durability of the raw material, and edge angle, reflecting the type of material to be scraped (hard bone as opposed to soft hides). The quartzites being much harder and more durable than siltstones and argillites may have been used for different scraping functions, however this remains to be demonstrated. Similarly the end scrapers were for the most part manufactured from chert and durable petrified wood, both of which had a steeper edge angle than the single much smaller argillite scraper (Figure 17, B,H,C).

(c) Distribution

With the exception of one quartzite flake scraper, which was recovered from the disturbed eastern edge of the site, all of the remaining scrapers were recovered in situ from the excavated units. The single gray chert end scraper fragment was found in level 1 of unit 25-10, but, as the top level of the site was found to be disturbed, it cannot be directly assigned to a specific cultural context. However, the remaining six scrapers were all taken from levels 2 and 3 of units 22-11, 36-24, and 46-28 which have been assigned to a Plains Archaic context on the basis of projectile point distribution.

BIPOLAR CORES AND FLAKES (Figure 18)

A total of twenty-one bipolar cores and nine bipolar flakes were recovered from the ten excavated units on the site. By definition bipolar reduction is a technique which involves the

TABLE 8: SCRAPER METRICS AND MORPHOLOGY

Unit	Level	Raw Material	Type Description	Metrics (mm)			
				Length	Breadth	Thickness	Edge Angle
22-11	3	Siltstone	Retouched flake scraper bi-lateral retouch	38.5	23.0	5.0	43^0
22-11	3	Quartzite	Retouched flake scraper distal retouch-snapped proximally			3.5	60^0
36-24	2	Siltstone	Retouched flake scraper distal retouch-snapped laterally	29.0		3.5	41^0
36-24	2	Argillite	Retouched flake scraper lateral-distal snapped laterally	24.0	20.5	5.0	47^0
Sur-face		Quartzite blue-grey fine-grained	Retouched flake scraper possible graver spur distal end, distal-bi-lateral retouch	41.0	30.0	6.5	63^0
25-10	1	Grey Chert	Fragment of end scraper	30.0		10	58^0
34-11	3	Petrified Wood	End scraper on Petrified Wood flake	62.3	21.5	7.5	77^0
46-28	3	Argillite	Small end scraper tri-angular in shape	17.0	14.0	4.0	55^0

> "...resting of core, or lithic implement, on anvil and striking the core with a percussor." (Crabtree 1972:42).

For purposes of this analysis, the core typology developed by Binford and Quimby was used to distinguish bipolar core types (Binford and Quimby 1963). With the exception of several of the quartzite cores, which were derived from fragments of larger cobbles, the majority of the cores represent split pebbles covering a range of raw material types. The presence of several large cobbles on the site with extensive pecking and pitting on one or both surfaces from use as anvil stones lends some credence to the interpretation of bipolar core reduction as opposed to reduction caused by use of the pebbles exclusively as wedges or pieces esquillees. This is not to negate the possibility that some or all of the cores may have served a secondary function as a wedge or slotting tool, both of which as MacDonald notes

> "...are associated with the groove and splinter technique of working bone, antler, ivory, and hard wood." (MacDonald 1968:88).

However, as Forsman suggests

> "...wedges were really only one of six varieties of bipolar cores and that, in some cases along with other bipolar forms, they served as blanks for further modification into artifacts." (Forsman 1975:20).

On a site such as FjPi-29 where large quantities of hard, durable quartzite detritus was readily available to serve any number of functions including wood and bone splitting, it would seem superfluous to go to the trouble of purposefully selecting and splitting a pebble of a less common material simply to obtain a fragment for splintering wood or bone. I would tend to agree with Forsman that initially the bipolar cores served as preforms for other lithic tool types such as scrapers.

(a) Raw Material Utilization

Table 9 presents a summary of the raw materials used in the bipolar reduction process by core type. Interestingly enough, quartzite was the most frequently used material accounting for eleven cores and one flake or 40% of the sample. Chert was a close second to quartzite accounting for five cores and six flakes or 36% of the sample. The miscellaneous

TABLE 9: RAW MATERIAL UTILIZATION BY CORE TYPE

Bipolar Core Type	Raw Material Type							
	Quartzite		Chert		Misc.		TOTAL	
Ridge Point	2	33.33 16.67	2	33.33 18.18	2	33.33 28.57	6	100 20.0
Point Area	1	20.0 8.33	3	60.0 27.27	1	20 14.28	5	100 16.66
Opposed Point	3	75.0 25.0	-	-	1	25.0 14.28	4	100 13.33
Ridge Area	3	75.0 25.0	-	-	1	25.0 14.28	4	100 13.33
Opposed Ridge	2	100 16.67	-	-	-	-	2	100 6.66
Bi-Polar Flakes	1	11.11 8.33	6	66.66 54.54	2	22.22 28.57	9	100 30.00
TOTAL	12	100 40.0	11	100 36.66	7	100 23.33	30	100 100

TABLE 10: BIPOLAR CORE AND FLAKE METRICS AND MORPHOLOGY

Core Type	Raw Material	METRICS (mm)				
		Length	Breadth	Thickness	Thickness/Breadth	Cobble Cortex
Ridge-Point	Quartzite	40.0	24.2	12.2	.50	-
	Quartzite	30.0	15.5	14.5	.77	+
	Misc.	35.5	22.5	14.5	.64	+
	Chert	26.5	21.2	8.5	.40	+
	Chert	39.0	26.5	14.5	.54	+
	Misc.	39.0	26.5	6.5	.24	+
Point-Area	Misc.	35.0	28.5	17.5	.61	+
	Quartzite	35.5	20.0	18.5	.93	-
	Chert	26.0	20.0	12.5	.63	+
	Chert	31.5	17.5	10.0	.57	+
	Chert	28.0	25.0	10.0	.40	+
Opposed-Point	Quartzite	35.5	17.5	10.5	.60	+
	Quartzite	34.5	17.3	11.0	.64	+
	Quartzite	27.5	18.5	15.0	.81	+
	Misc.	41.5	18.5	13.0	.70	+
Ridge-Area	Quartzite	53.8	30.5	18.5	.61	+
	Quartzite	37.5	26.8	15.0	.56	+
	Quartzite	35.5	25.5	21.5	.84	-
	Misc.	41.5	31.0	11.5	.37	+
Opposed-Ridge	Quartzite	30.5	22.0	10.9	.50	+
	Quartzite	35.2	29.7	10.3	.35	+

category was composed of various siltstones, argillites and unidentified raw materials and represented only 23% of the total sample with five cores and two flakes. Forsman in his article on bipolar technology notes that the opposed ridge core is the type generally referred to as a "wedge" (Forsman 1976:18). At FjPi-29 this type of core had the lowest frequency of all core types. Interestingly enough however, the two examples recovered were both manufactured from quartzite, which in terms of resilience would be the most effective of the utilized raw materials, assuming that they did function as wedges. Morphologically however these two cores were not distinguishable from the other cores in terms of extreme battering or crushing. Similarly, they were not distinguishable from the other cores metrically, as they fit well within the metric ranges of the other core types. As Forsman has pointed out "The sole distinction which could be made between these specimens was overall form..." however the significance of this distinction has yet to be demonstrated (1976:18).

(b) Metrics and Morphology

The metrics and morphology for each of the five recognized bipolar core types from the site is presented in Table 10. Morphologically the cores were divided into five types based on the Binford-Quimby typology. Metrically, within types, the cores manufactured from quartzite were larger than the cores manufactured from other raw materials. This may in part be explained by the fact that the quartzites represented fragments taken from larger cobbles for bipolar reduction, while the other raw materials represented smaller complete pebbles which inherently limited their size range. Between core types, the ridge area cores were much larger dimensionally than any of the other types. While the remaining four core categories were metrically within range of each other. Morphologically all of the cores manufactured from raw materials other than quartzite, retained some portion of the original cobble or more specifically pebble cortex. Only among the quartzite cores was the cobble cortex absent, and then only in three out of the eleven recorded cores. Again this absence may be attributed to the fact that the quartzite cores represented further reduction of fragments taken from larger broken cobbles, and in some cases fragments from the interior of the cobble, hence, no cortex.

TABLE 11: DISTRIBUTION OF BIPOLAR CORES AND FLAKES BY ARBITRARY 10 cm LEVELS-ALL UNITS

Bipolar Core Types	LEVEL											
	1		2		3		4		5		TOTAL	
Ridge Point	1	16.66 25.0	-	-	5	83.33 50.0	-	-	-	-	6	100 20.0
Point Area	-	-	4	80.0 36.36	1	20.0 10.0	-	-	-	-	5	100 16.66
Opposed Point	-	-	1	25.0 9.09	1	25.0 10.0	2	50.0 40.0	-	-	4	100 13.33
Ridge Area	2	50.0 50.0	-	-	-	-	2	50.0 40.0	-	-	4	100 13.33
Opposed Ridge	-	-	2	100 18.18	-	-	-	-	-	-	2	100 6.66
Bipolar Flakes	1	11.11 25.0	4	44.44 36.36	3	33.33 30.0	1	11.11 20.0	-	-	9	100 30.0
TOTAL	4	100 13.33	11	100 36.66	10	100 33.33	5	100 16.66	-	-	30	100 100

TABLE 12: BIPOLAR CORE AND FLAKE RAW MATERIAL FREQUENCY DISTRIBUTION BY ARBITRARY LEVEL

Level	Raw Material Type						Total	
	Quartzite		Chert		Misc.			
1	2	50.0 16.67	1	25.0 9.09	1	25.0 14.28	4	100 13.33
2	4	40.0 33.33	4	40.0 36.36	2	20.0 28.57	10	100 33.33
3	4	36.36 33.33	5	45.45 45.45	2	18.18 28.57	11	100 36.66
4	2	40.0 16.67	1	20.0 9.09	2	40.0 28.57	5	100 16.66
5	-	-	-	-	-	-	-	-
TOTAL	12	100 40.0	11	100 36.67	7	100 23.33	30	100 100

It is difficult to envision the core typology as developed by Binford and Quimby as actually representing specific types of cores purposefully shaped to that form by a knapper. The bipolar technique of lithic reduction would not seem amenable to the control necessary to accomplish this. Rather the core types may represent stages in a structured process of core reduction leading ultimately to exhaustion of the core at a point where the fragment becomes too small to either hold on the anvil or to produce usable flakes (Kobayashi 1975:116). At this point the core could have been discarded or utilized for another function, possibly as a wedge. This is however conjectural and remains to be demonstrated experimentally.

(c) Distribution

The distribution of bipolar cores and flakes on the site was considered both in terms of distribution by core type and raw material type by arbitrary ten centimetre level. Tables 11, 12 present a summary of these distributional data. In terms of total core and flake distribution, the majority of the artifacts were recovered from levels 2 (36%) and 3 (33%) decreasing by half to 16% in level 4 and zero in level 5. The remaining four cores and flakes were recovered from level 1. Levels 2 and 5, as previously mentioned, has been assigned to a Plains Archaic context, while level 1 was disturbed. Core types were fairly homogeneously distributed between levels with only the opposed ridge variety clustering on one level (level 2) but from separate units. Again the majority of core types were recovered from levels 2 and 3. The apparent concentration of cores and flakes in levels 2 and 3 may in part be attributed to the fact that, while all of the excavated units went at least to the depth of level 3, not all of the units included material to a depth of level 4 (30-40 cm below surface). In light of the limited amount of the total site area that is represented by ten excavation units, the artifact sample and distribution is undoubtedly skewed. Similarly, in Table 12, the trend towards artifact concentrations in levels 2 and 3 may again be more apparent than real. The raw material distribution is also regarded as being homogeneous.

SPLIT PEBBLES

This artifact category consisted to small pebbles (less than 3.0 cm in length for the most part), which had been split in half either longitudinally or laterally. Unlike the bipolar cores however, the pebbles

TABLE 13: SPLIT PEBBLE RAW MATERIAL FREQUENCY AND DISTRIBUTION BY LEVEL

Level	Raw Material													
	Quartzite		Chert		Siltstone		Argillite		Petrified Wood		Miscellaneous		Total	
1	10	58.82 10.64	2	11.76 13.33	1	5.88 4.55					4	23.53 7.27	17	8.99
2	25	37.88 26.60	5	7.58 33.33	6	9.09 27.27	1	1.52 5.00			29	43.94 52.73	66	34.92
3	19	41.30 20.21	5	10.87 33.33	10	21.74 45.45	1	2.17 50.0	1	2.17 10.0	10	21.74 18.18	46	24.34
4	40	66.67 42.55	3	5.0 2.00	5	8.33 22.73					12	20.0 21.82	60	31.75
5	-	-	-	-	-	-	-	-	-	-	-		-	-
Total	94	49.74	15	7.94	22	11.64	2	1.06	1	.53	55	29.10	189	100/100

displayed no observable bulb of percussion or flake scars.

(a) Raw Material Utilization

As was the case with the bipolar cores, the majority of the split pebbles (94-49.74%) were quartzite. Unlike the cores however, the miscellaneous category comprised the second most frequently utilized raw material (55-29.10%). The miscellaneous category consisted primarily of very coarse gained siliceous pebbles, which may be of a poor quality sandstone origin. Siltstone (22-11.64%) and chert (15-7.94%) were the remaining two commonly occurring raw material types. Argillite and petrified wood in negligible quantities completed the raw material sample.

(b) Distribution

A summary of the split pebble distribution in the excavation units is presented by raw material type and arbitrary level in Table 13. The majority of the split pebbles were recovered from levels 2-4, with a slightly higher frequency of pebbles occurring in level 2 (66-34.92%) than in level 4 (60-31.75%). Level 3 accounted for 46% of the 189 recovered split pebbles or 24.34% of the sample. The raw material frequencies for the major material types followed a similar distributional pattern. The frequency distribution of split pebbles closely paralleled that noted for the bipolar cores, the major difference being the higher frequency of split pebbles in level 4 as opposed to level 3 for the cores.

(c) Form and Function

The exact function of the split pebbles is at present enigmatic. Their presence in such large numbers in an unequivocal cultural context would at present seem to deny the probability of their being a natural occurrence. The size and form of the pebbles suggests an affinity with the bipolar technology demonstrated by the presence of bipolar cores, anvil stones and hammerstones in a cultural context. Assuming this affinity to be true, then theoretically the split pebbles could represent material split and selectively discarded from the bipolar reduction process on the basis of size, form and most importantly, material defects. If this is the case then the presence and importance of bipolar technology assumes a more significant role in the overall lithic technology of the site.

Further excavation at the site would serve to demontrate this association between bipolar cores and split pebbles if present. Controlled experimentation could be used as a means of confirming the viability of splitting pebbles using the bipolar technique.

COBBLE CORES AND SPLIT COBBLES (Figure 19)

By definition, cores are

> "...pieces of lithic material showing one or more negative flake scars, and may be considered as a by-product of the manufacture of flakes and blades." (Bucy 1971:74).

The artifact sample was divided into the two basic categories, cobble core and core fragments, as defined above, and split cobbles and cobble fragments displaying no secondary flaking. A total of 41 cores and 49 core fragments were identified, 15 of the cores and 31 of the core fragments were recovered in the excavation units, the rest came from the surface along the eastern edge of the site. Of the nine split cobbles and thirteen cobble fragments, five of the split cobbles and nine of the fragments were recovered subsurface.

(a) Raw Material Utilization

Table 14 presents a summary of the raw materials selected for cobble reduction. Quartzite at 54% of the total sample was the preferred raw material followed closely by petrified wood (41%), the remaining 5% of the sample was divided between chert (2 specimens - 1.79%), quartz (1 specimen - .89%) and a single unidentified core (.89%). Presumably these percentages are a reflection of the availability of the various raw materials, as petrified wood tends to either split longitudinally into thin plates along the original growth rings, or block fracture, making it a difficult raw material to knap and theoretically less desirable than other raw materials where a choice exists.

(b) Metrics and Morphology

The metrics and morphology of individual quartzite, quartz and chert cobble cores and split cobbles are presented in Table 15. The core sample was divided into two basic categories based on the pattern of flake removal. The first and most common grouping consisted of cores with multi-

TABLE 14: RAW MATERIAL UTILIZATION IN COBBLE REDUCTION - TOTAL SAMPLE

Raw Material	Reduction Category									
	Cobble Core		Core Fragment		Split Cobble		Cobble Fragment		Total	
Quart-zite	18	29.51 43.90	22	36.07 44.90	8	13.11 88.89	13	21.31 100	61	100 54.46
Pet. Wood	19	40.43 46.34	27	57.45 55.10	1	2.13 11.11	-	-	47	100 41.96
Quartz	1	100 2.44	-	-	-	-	-	-	1	100 .89
Chert	2	100 4.88	-	-	-	-	-	-	2	100 1.79
Misc.	1	100 2.44	-	-	-	-	-	-	1	100 .89
Total	41	36.61	49	43.75	9	8.04	13	11.61	112	

TABLE 15: QUARTZITE, QUARTZ AND CHERT COBBLE CORE, SPLIT COBBLE METRICS AND MORPHOLOGY

			Metrics (cm gms)			
Unit	Level	Description	Length	Breadth	Thickness	Weight
22-11	3 (1333)	Multi-directional cobble core-quartzite	9.20	70	3.40	225.23
22-11	4 (1454)	Multi-directional cobble core-quartzite	13.50	6.15	8.75	673.52
28-11	3 (1984)	Multi-directional cobble core-quartzite and anvil-stone	16.0	13.15	9.75	73 kilo
28-11	3 (1995)	Multi-directional cobble core-quartzite	12.25	5.65	7.95	898.11
25-10	2 (872)	Multi-directional cobble core-quartzite	11.30	6.45	4.15	331.16
28-11	3 (1991)	Multi-directional cobble core-quartz	6.20	5.55	2.55	104.46
22-11	3 (1203)	Split-cobble-long axis-Quartzite (bipolar)	7.40	5.45	2.60	125.34
22-11	3 (1353)	Cobble core-flake removal distal and proximal ends-long axis-quartzite (bipolar)	12.15	7.85	3.75	428.58
25-10	1 (819)	Split cobble-broken across short axis-quartzite	13.85	12.0	7.80	1299.82
28-11	3 (1999)	Split cobble-long axis quartzite	15.30	9.40	4.70	908.31

TABLE 15: (Continued)

Unit	Level	Description	Metrics (cm gms)			
			Length	Breadth	Thickness	Weight
31-10	3 (2829)	Split cobble-long axis-quartzite	8.90	7.35	25.5	190.72
28-11	3 (1990)	Cobble core-unifacial flake removal-proximal end-long axis-chert	7.0	5.30	1.95	83.78
Surface	(505)	Cobble core-flakes removed from distal and proximal ends-long axis-quartzite	10.80	7.55	5.26	538.14
Surface	(571)	Cobble core-unifacial removed of flakes-one end-long axis-quartzite	9.65	7.65	3.30	280.76
Surface	(591)	Cobble core-flake removed distal and proximal ends dorsally and ventrally-long axis-quartzite	12.05	7.20	3.80	361.11
Surface	(599)	Multi-directional cobble core-quartzite	7.10	7.00	3.15	140.53
Surface	(607)	Cobble core-flake removal distal and proximal ends dorsally and ventrally-long axis-quartzite	7.60	4.60	3.10	120.24
Surface	(660)	Multi-directional cobble core-quartzite	11.25	9.50	6.45	782.24
Surface	(670)	Multi-directional cobble core-quartzite	13.0	6.20	9.15	648.0

TABLE 15: (Continued)

Unit	Level	Description	Metrics (cm gms)			
			Length	Breadth	Thickness	Weight
Surface	(697)	Multi-directional cobble core-quartzite	12.50	12.15	6.85	938.47
Surface	(2544)	Multi-directional cobble core-quartzite	15.0	10.50	7.20	1103.95
Surface	(2545)	Multi-directional cobble core-quartzite	13.75	9.15	4.80	623.72
Surface	(2547)	Multi-directional cobble core-quartzite	10.45	8.75	6.55	649.32
Surface	(2551)	Cobble core-flakes removed from distal and proximal ends bifacially-long axis-quartzite	18.150	11.55	4.55	887.98
Surface	(658)	Split cobble-long axis-quartzite	8.55	8.35	2.75	282.64
Surface	(681)	Split cobble-long axis-quartzite	18.10	6.95	3.40	715.50
Surface	(2542)	Split cobble-quartzite	8.50	7.50	2.45	205.70
Surface	(2550)	Split cobble-quartzite	12.35	9.75	3.65	543.15
Surface	(544)	Multi-directional cobble core-chert	5.20	5.15	2.15	72.45

faunal or multi-directional flake scars and accounted for 14 of the 21 cores or 66.67% of the sample. The second category was represented by 7 cores (33.33%) with flakes removed from either one or both ends of either a split or complete cobble along the long axis of the core. The split cobbles were also divided into two groups on the basis of direction of splitting. Five of the eight split cobbles (62.50%) were split along the long axis of the cobble, and in one if not all cases splitting was accomplished by bipolar percussion. The remaining three cobbles were split across the short axis or breadth of the cobble.

Metrically, the mean dimensions and range of the longitudinally split cobbles were closest to those of group two cores. (Table 16). The group two cores were in an intermediate position between the split cobbles and group one cores in terms of mean dimensions. The length, breadth and thickness range for all three groups did, however, overlap. In the case of some of the group two cores where flakes were removed from unsplit cobbles, the flakes removed could represent either aborted attempts to split the cobble or purposeful preliminary flake removal from a potential core. The longitudinally split cobbles could represent either core preforms, that is a cobble split to provide a striking platform for flake removal, or a preform subsequently reduced to a finished artifact form. In terms of overall dimensions and form, the multi-directional cores were slightly shorter and definitely wider and thicker than the longitudinally split cobbles or the cobbles flaked along the long axis. Flake removal was much more extensive on these cores, suggesting that the ultimate goal was removal of flakes for the flakes themselves, rather than to modify the block of material into a finished form. Potentially then, we may be dealing with two different aspects of a reductive technocomplex, both of which are initially based on cobble alteration. Again, this remains to be demonstrated conclusively.

(c) Distribution

Table 17 presents a summary of the site distribution of the combined sample of excavated quartzite, quartz and chert split cobbles and cobble cores, by unit level. Similar distributional data for the petrified wood cobble cores and cobbles is presented in Table 18. From Table 17, it is apparent that while quartzite, quartz or chert cobbles or cobble cores

TABLE 16: COBBLE CORE, SPLIT COBBLE - COMPARATIVE METRICS BY TYPE

Dimension (cm)	Cobble Form		
	Multi-directional Core (N-14)	Flake Removal-Long Axis (N-8)	Split Cobbles-Long Axis (N-5)
Mean Length	11.19	11.63	10.98
Mean Breadth	8.03	7.64	7.60
Mean Thickness	5.92	3.80	2.97
Range:Length	5.20-16.0	7.0 -18.50	8.50-18.10
Breadth	5.15-13.15	5.30-11.55	1.95-5.25
Thickness	2.15-9.75	1.95-5.25	2.45-3.65

TABLE 17: QUARTZITE, QUARTZ, CHERT COBBLE AND COBBLE CORE DISTRIBUTION - UNIT-LEVEL

Unit	Level (10 cm) 1		2		3		4		5		
22-11	-		-		7	70.0 36.84	3	30.0 37.50	-	10	100 30.30
25-10	1	20.0 50.0	4	80.0 100	-		-		-	5	100 15.15
28-11	1	10.0 50.0	-		8	80.0 42.11	1	10.0 12.50	-	10	100 30.30
31-10	-		-		1	5.26	-		-	1	3.03
34-11	-		-		1	50.0 5.26	1	50.0 12.50	-	2	100 6.06
37-10	-		-		1	50.0 5.26	1	50.0 12.50	-	2	100 6.06
35-22	-		-		-		1	100 12.50	-	1	100 3.03
36-24	-		-		1	100 5.26	-		-	1	100 3.03
45-23	-		-		-		-		-	-	
46-28	-		-		-		1	12.50	-	1	3.03
Total	2	100 6.06	4	100 12.12	19	100 57.58	8	100 24.24	-	33	

TABLE 18: PETRIFIED WOOD COBBLE AND COBBLE CORE DISTRIBUTION - UNIT-LEVEL

Unit	Level (10 cm)					
	1	2	3	4	5	Total
22-11	-	3 100 25.0	-	-	-	3 100 11.11
25-10	1 100 20.0	-	-	-	-	1 100 3.70
28-11	-	-	-	-	-	-
31-10	-	-	-	-	-	-
34-11	-	3 100 25.0	-	-	-	3 100 11.11
37-10	3 33.33 60.0	3 33.33 25.0	-	3 33.33 42.86	-	9 100 33.33
35-22	-	-	-	-	-	-
36-24	-	-	-	-	-	-
45-23	1 10.0 20.0	3 30.0 25.0	2 20.0 66.67	4 40.0 57.14	-	10 100 37.04
46-28	-	-	1 100 33.33	-	-	1 100 3.70
Total	5 100 18.52	12 100 44.44	3 100 11.11	7 100 25.93	-	27 100 100

were recovered from every unit except unit 45-23, the bulk of the material was concentrated in units 22-11, 25-10 and 28-11 on Line A near the southeastern edge of the site along the ravine. All of the material from unit 22-11 was clustered in levels 3 and 4 and, similarly, all but one of the cobbles and cores from unit 28-11 were recovered from the same levels (Figure 3). The majority of the material from unit 25-10, however came from level 2. The fact that unit 25-10 was situated on an incline rising from unit 22-11 up to unit 28-11, and that the cultural deposits in unit 25-10 terminated in level 3 of this unit as opposed to level 5 in 22-11 and level 4 in 28-11, may account for this difference in vertical distribution. The concentration of cores in these units, coupled with the heavy concentration of debitage in unit 22-11, suggests that the test units were situated over a major lithic reduction activity area which probably centred on unit 22-11.

The petrified wood cobbles and cobble cores were distributed between three sets of paired units, units 22-11 and 25-10, 34-11 and 37-10 all on line A along the ravine, and units 45-23 and 46-28 on line 2 north of the ravine (Figure 3). The major concentration of petrified wood cores and cobbles were recovered from units 37-10 (9-33.33%) and 45-23 (10-37.04%). However, unit 45-23 had the highest percentage of petrified wood debitage (27%) of all the units, followed by units 46-28 (15.7%) and 37-10 (11.0%), suggesting that units 46-28 and 45-23 are situated on a major area of petrified wood reduction, with a secondary activity area around unit 37-10 (Figure 9).

(d) Experimentation

In a brief series of preliminary experiments to test methods of reducing petrified wood cobbles, the authors found that direct percussion of hand held cobbles tended to result in block fracturing of the cobble into unusable fragments. However, when the cobble was aligned longitudinally on an anvilstone and struck with a hammerstone, the cobble tended to split into flat usable plates along the growth rings of the original wood (Figures 20, 21). The presence of petrified wood flakes and cobble fragments on the site similar to those derived experimentally may give some credence to the experiments (Figure 22).

HAMMERSTONES AND ANVILSTONES (Figure 23)

In essence, lithic technology is a process which involves "reducing the initial mass of lithic material to the finished product" (Crabtree 1972:1). The process of forming this finished product or artifact "...from the initial break of the raw material to the finished tool usually requires several stages of manufacture and the use of several different kinds of fabricators." (1972:7). In this section of the report we are in essence considering two particular broad categories of "fabricators" which form a part of this reductive system.

(a) Metrics and Morphology

The eleven artifacts comprising the hammerstone/anvilstone tool classification were grouped into three basic categories on the basis of observable patterns of use-wear. The hammerstones, with one exception, consisted of smooth "ovate" cobbles displaying patterned marginal battering either at the distal and/or proximal ends of the cobble or on the margins all around the cobble. The exception was in the form of a single cylindrical hammerstone with impact facets on the left margin and one face at the proximal end of the cobble. Anvilstones were represented by three specimens, two of which were ovate cobbles, one deeply pitted bifacially, the other a much larger cobble with extensive pitting on one face which had served a secondary function as a cobble core. The third anvilstone was triangular in shape with shallow pitting at the apex of the triangle. The third category consisted of a single ovate cobble which had functioned primarily as an anvilstone displaying deep pitting bifacially and secondarily as a hammerstone evidenced by light marginal battering. The metrics and morphology of the total sample are summarized in Table 20.

(b) Raw Material Utilization

In terms of the total artifact sample, seven of the eleven specimens (63%) were manufactured from quartzite, one (9.9%) from granite and the remaining three from silicified sandstone. Of the seven quartzite specimens, four (57%) were hammerstones, two (28%) anvilstones and the remaining artifact a combination anvilstone/hammerstone. The three silicified sandstone fabricators included two hammerstones and one anvilstone, while the single granite fabricator was a hammerstone.

TABLE 19: COBBLE AND COBBLE CORE DISTRIBUTION - ARBITRARY LEVEL AND SURFACE

Raw Material	Level (All Units)										Total	
	1		2		3		4		Surface			
Quartzite	2	3.27 28.57	3	4.91 20.0	17	27.86 77.27	9	14.75 56.25	30	49.18 57.69	61	100 54.46
Petrified Wood	5	10.63 71.42	12	25.53 80.0	3	6.38 13.63	7	14.89 43.75	20	42.55 38.46	47	100 41.96
Chert	-		-		1	50.0 4.54	-		1	50.0 1.92	2	100 1.78
Quartz	-		-		1	100 4.54	-		-		1	100 .89
Miscellaneous	-		-		-		-		1	100 1.92	1	100 .89
Total	7	100 6.25	15	100 13.39	22	100 19.64	16	100 14.28	52	100 46.42	112	100 100

TABLE 20: HAMMERSTONE/ANVILSTONE METRICS AND MORPHOLOGY BY UNIT-LEVEL

Unit	Level	Raw Material	Shape	Description	Metrics (cm)			
					Length	Breadth	Thickness	Weight (gms)
Surface (2553)		Quartzite	Ovate	Anvilstone-Hammer-stone. Deeply pecked depressions Bifacially-slight marginal battering	9.25	8.40	5.60	630.12
Surface (2554)		Quartzite	Ovate	Hammerstone-margin-al battering distal and proximal ends	11.20	2.40	5.20	750.90
22-11 (1407)	3 (20-30cm)	Possibly Siliceous Sandstone	Elongated Cylindri-cal	Elongated Hammer-stone, Hammer facets left margin proximally, and on ventral face,proxi-mally	14.10	4.80	3.90	324.44
28-11 (1984)	3	Large Quartzite Cobble	Ovate	Anvilstone-second-ary use as cobble core-extensive pecking dorsally	16.00	13.15	9.75	3 kilo
31-10 (2827)	3	Possibly Silicified Sandstone	Ovate	Hammerstone-heavy battering at proxi-mal end resulting in flake removal	10.35	7.15	6.60	595.35
31-10 (2828)	3 (20-30cm)	Granite	Ovate	Extensive faceting lateral and proxi-mal margins-Hammer-stone	7.62	7.65	5.55	422.32

TABLE 20: (Continued)

Unit	Level	Raw Material	Shape	Description	Metrics (cm)			
					Length	Breadth	Thickness	Weight (gms)
31-10 (3951)	4 (30-40cm)	Quartzite	Ovate	Hammerstone-faceting Marginally all around cobble	7.85	6.85	4.25	368.12
35-22 (2986)	4	Quartzite	Ovate	Hammerstone-faceting on margins at distal and proximal ends, slight pecking on one face	9.00	6.75	4.05	358.15
45-23 (3460)	3 (20-30cm)	Silicified Sandstone	Triangular	Anvilstone-slight pecking resulting in shallow pitting on peak of cobble	12.00	13.00	8.00	571.0
45-23 (3508)	4 (30-40cm)	Quartzite	Ovate	Hammerstone-marginal hammer facets-distal and proximal ends	11.00	8.90	5.15	657.62
37-10 (31-28)	4 (30-40cm)	Coarse Quartzite	Ovate	Anvilstone-heavily pecked on both faces	10.40	8.50	5.10	547.77

Crabtree, discussiong flaking implements, makes the observation that in the reduction process "Each method requires a separate tool kit, but the compressor or percussor (fabricators) must be of material different from the stone being worked." (1972:7). For purposes of debitage sampling in this report, the lithic debris from three units, representing a total sample of 1959 artifacts were analyzed. It was found that 1481 or seventy-five percent of this sample was comprised of quartzite. Obviously, quartzite hammerstones and anvilstones, as discussed above, were being used to manufacture quartzite artifacts on the site. With a measure of seven on the MOHS hardness scale it would be difficult to obtain a locally available cobble of a different material than quartzite, resilient enough to serve as an impactor for manufacturing quartzite artifacts (Sorrel 1973: 155). Similarly both Bucy and Losey record the use of hammerstones of the same material as the raw material being flaked, basalt nodules at the Midvale Quarry and quartzite nodules at the Beaver Creek Quarry (Bucy 1971:73), (Losey et.al. 1974:99).

(c) Distribution

The hammerstones and anvilstones, with the exception of the two specimens that were surface collected, were all recovered from either level 3 (5-54%) or level 4 (4-36%). Three hammerstones were recovered from each level while two anvilstones, came from level 3 and one from level 4. Six of the ten excavated units contained either a hammerstone, anvilstone or both. As evidenced in the following table, there were no obvious clusters of impactors on the site but rather, as with the bipolar cores, the distribution was more or less homogeneous (Table 21).

TABLE 21: HAMMERSTONE, ANVILSTONE DISTRIBUTION BY UNIT-LEVEL

Unit	Level (Arbitrary 10 cm)		
	3	4	Total
22-11	1	-	1
28-11	1	-	1
31-10	2	1	3
37-10	-	1	1
35-22	-	1	1
45-23	1	1	2
TOTAL	5	4	9

(d) Inter-Site Comparisons

In his report on the Stony Plain Quarry site, Losey comments on the scarcity of utilized hammerstones on the site, an absence which he felt was unusual in view of the sites function. Losey explains this absence in part in terms of the material being worked noting that:

> "The hardness of quartzite on MOHS Scale is 7. This would seem to necessitate the use of stone hammers of at least similar hardness insofar as the preparation of cores is concerned. Quartzite cobbles and pebbles were convenient source." (Losey 1971:153).

Losey suggests that damaged or exhausted hammerstones could have been used as cores in a cyclical process which would have effectively incorporated impactors into the reduction process as sources of raw material. Losey supports this hypothesis by noting the presence of pitting and battering on several decortication flakes "...which appear to be derived from the surface of stone hammers..." as well as pitting on some of the large cobble spalls "...as usually seen on the surface of stone anvils..." (1971:153).

Of the eleven hammerstones and anvilstones from FjPi-29, only the largest of the anvilstones (1984), demonstrated secondary use as a cobble core (Figure 24). As previously mentioned, seven of the eleven fabricators from the site were manufactured on quartzite cobbles, of these only the above mentioned anvil showed secondary reduction. Hammerstones in an unaltered form were also present at two other sites identified as quarries (Beaver Creek, Midvale). Perhaps the Stony Plain Quarry site represents an unusual situation where impactor reduction was the rule rather than the exception, or perhaps as Losey alternately suggests "...stone hammers were discarded elsewhere and not recovered in the excavation." (1971:153).

Brumley reports a total of eight hammerstones and three anvilstones from the Cactus Flower site. The hammerstones were divided into three general shape categories; spherical (2), cylindrical (3) and thin ovate (3). Seven of the eight hammerstones were utilized argillite pebbles or cobbles, the eighth specimen was a sandstone cobble (Brumley, 1975:58).

Eighteen complete and twenty-seven fragmentary hammerstones were recovered from the Beaver Creek Quarry site. Of these forty-one were quartzite and four granite. In contrast to this abundance of hammerstones, only one quartzite anvilstone was reported (Losey et.al. 1974:99).

Table 22 presents a comparison of the range and mean for the length, breadth and thickness of hammerstones from FjPi-29, Beaver Creek and Cactus Flower. Metrically, the hammerstones from FjPi-29 are larger in overall dimension than those from the other two sites. The hammerstones from Cactus Flower are noticeably smaller than those from Beaver Creek which are metrically closest to FjPi-29 in overall size. The marked size variation between hammerstones from Cactus Flower and the other sites may in part be a reflection of raw material selection. Both the Beaver Creek site and FjPi-29 demonstrated a preference for large quartzite and granite cobbles for hammerstones whereas the Cactus Flower hammerstones were almost exclusively produced on large argillite pebbles and small cobbles. It would be difficult to account for this size differential on the basis of function as at all three sites at least a part of the knapping process involved the initial reduction of cobbles and cobble spalls, which were primarily quartzites.

TABLE 22: COMPARATIVE HAMMERSTONE METRICS

Measurement (cm)	Site					
	FjPi-29 (N-7)		Beaver Creek (N-18)		Cactus Flower (N-8)	
	Range	Mean	Range	Mean	Range	Mean
Length	7.62-14.10	10.16	S.D. 2.33	7.48	5.97-8.34	7.47
Breadth	4.80-8.90	7.21	S.D. 1.50	6.15	4.06-6.85	4.70
Thickness	3.90-6.60	4.96	S.D. .84	4.37	1.46-5.82	3.04

(e) Form and Function

In the past few years a number of experiments have been conducted which have been directed towards the replication of prehistoric lithic technology. At least two of these experimentors, while concerned primarily with the technique and bi-products of percussion flaking, also made observations on the optimum weight and form of the impactors being used, observations which may be applicable to the hammerstone sample from FjPi-29. Dickson in his experiments with the direct percussion flaking

of hand held quartz "lumps" and the bipolar reduction of smaller blocks of quartz, noted that for working quartz the hammerstone;

> "...should be heavy compared with the minimum sized core that can be held in the hand. Its function is to provide the kenetic energy for breaking pieces off the core, by virtue of both its mass and its velocity at the instant of impact." (Dickson 1977:99).

Dickson found that if the hammer was too light it was difficult to "... move it fast enough and still more difficult to have adequate control over the point and angle of impact." (1977:99). Similarly, "Too massive a hammer was clumsy to handle", "...and equally hard to control."

During his initial investigation, Dickson used a variety of hammerstones ranging from 165 to 1100 grams in weight. Dickson found the optimum weight range to be between 300 to 400 grams, adding that a "...waterworn pebble makes a good hammer as it provides useful contours and is unlikely to have easy fracture planes." (1977:99).

In terms of wear patterns on the hammerstones, Dickson observed that

> "The pattern of wear on a hammer varies with its application, its shape and the way in which the operator handles it." (1977:99).

Dickson noted that cylindrical hammers were used largely "end-on" and to a lesser degree "side-on" that is bifacially as opposed to bilaterally, whereas the lateral edges of the oval hammerstones were most effective for bipolar reduction and the tips of the broader faces for "...the initial dislodgement of broad flakes from angular work pieces." (1977: 99).

Kobayashi in his experiments with bipolar reduction noted that the size and weight of the hammerstone was of some importance, as "These factors determine the size and thickness of flakes removed from cores." (Kobayashi 1975:116). Kobayashi found that a lightweight hammerstone with a convex head was best for removing "...thin, tiny bipolar flakes", whereas a "heavy" hammerstone with a straight edge and U-shaped cross-section was necessary for the removal of large, thick flakes (1975:116). The "lightweight" hammerstone illustrated by Kobayashi weighed 653 grams and measured 13.18 cm long by 6.66 cm wide. His heavy hammerstone weighed 2.20 kilograms and measured 17.89 cm long by 9.40 cm wide. (1975, plates 1a, 1b).

The six ovate hammerstones from FjPi-29, had a mean weight of 525.41 grams and a range of 358.15-750.90 grams. Only three of the six hammerstones fell within Dickson's optimum weight range, the remaining three could be equated with Kobayashi's "lightweight" hammerstone category. All six specimens displayed the "side-on" or lateral wear patterns that Dickson equated with bipolar reduction and Kobayashi with the removal of thin bipolar flakes. The single cylindrical hammerstone in the sample from FjPi-29, showed the heaviest use-wear unifacially and only slight unilateral faceting, a wear pattern that agrees with Dickson's observation on the use of cylindrical hammerstones. On the basis of both Dickson's and Kobayashi's experimental observations, the wear patterns and form of the hammerstones from FjPi-29 suggest that they were used primarily for bipolar reduction. However bipolar reduction represents only a portion of the overall lithic industry on the site, an industry which, judging from the lithic debitage, was oriented towards biface production. Obviously some form of impactor was used to manufacture these bifaces. Theoretically a soft hammer technique could have been employed, particularily in the modification of spall blanks into bifaces and unifaces where a hard hammer may have been detrimental considering the thin edges of the spalls. This doesn't negate the possibility that hard hammers were employed in this reduction industry as well. (Ranere 1975:185). Both Dickson's and Kobayashi's experiments have given insight into one particular facet of the lithic reduction industry, however their work also serves to demonstrate the need for further structured experimental programs aimed at other aspects of lithic technology.

DEBITAGE

(a) Sample Size and Selection

The debitage sample consisted of the detritus from three of the ten excavated units, representing a total of 1959 flakes and flake fragments or approximately 50% of the total unit sample. The three units (22-11, 36-24, 46-28) were selected on the basis of the debitage frequency in each unit and the units location on the site. One unit was taken from each of the three sampled survey lines (line A, Line 0, line 1) to provide a means of comparing debitage density and composition between test areas (Figure 3).

(b) Typology

The basic flake typology used in this analysis follows that established by Bucy as the basis of lithic experimentation and Losey (Bucy 1971:75-79), (Losey et.al. 1974:36-38). Both authors deal specifically with lithic debris from quarry-workshop sites. By following these established typologies the data from FjPi-29 can be compared directly to the data base presented by both Bucy and Losey.

(c) Raw Material Utilization

Table 23 presents a summary of the debitage from units 22-11, 36-24, 46-28 by flake type and raw material type. Without exception quartzite was the predominant raw material type in all flake categories accounting for a total of 1481 flakes or 75.59% of the total sample. All of the large spalls and biface thinning flakes were quartzite as were the majority of other flakes with the exception of block and shatter flakes. Petrified wood was second in frequency accounting for 314 flakes or 16.02% of the total sample. Predictably, 50% of the block and shatter flakes were petrified wood, confirming the tendency for this material to either shatter, or break along planes following the growth rings of the original wood, when impacted. Chert including chalcedony and flint accounted for 5.23% of the sample and the final 3.10% was composed of argillites, siltstones, sandstones and unidentified materials all included in the miscellaneous category.

(c) Distribution

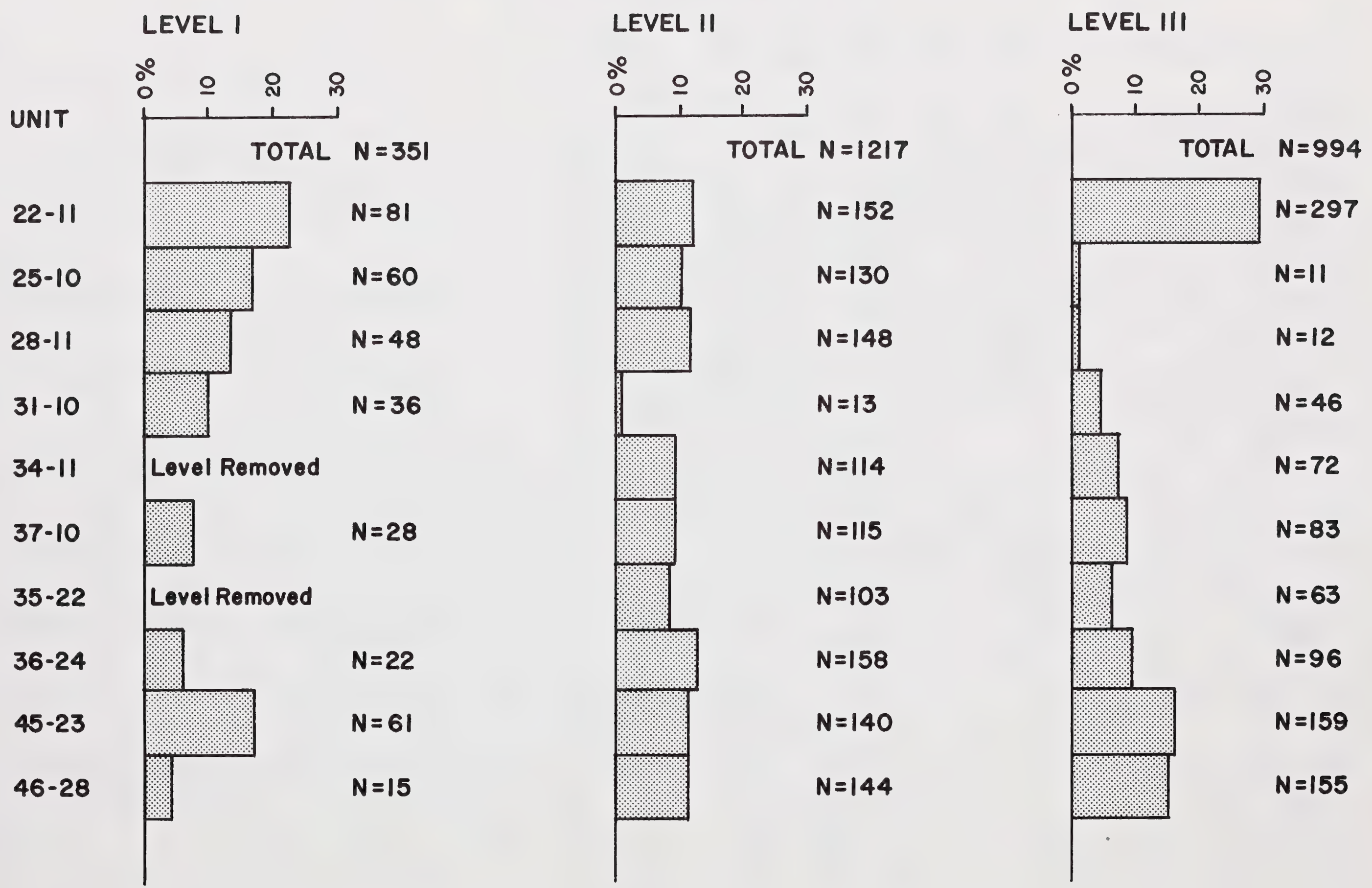
Of the three units analyzed, unit 22-11 was by far the most prolific accounting for 1270 of the 1959 analyzed flakes or 64.83% of the sample (Figure 11). Units 46-28 and 36-24 accounted for the remaining sample at 22.66% and 12.51% respectively (Table 24). The majority of the biface thinning flakes and retouch and thinning (manufacture) flakes were recovered from unit 22-11 distantly followed by unit 26-28. Unit 22-11 also dominated in the percentage frequency occurrence of the remaining six flake types. The concentration of debitage in unit 22-11, combined with the presence of other artifacts associated with processes of lithic reduction (cores, hammer and anvilstones) suggests the presence of a major lithic activity area either centered on or in close proximity to this

TABLE 23: RAW MATERIAL UTILIZATION-UNITS 22-11, 36-24, 46-28, ALL LEVELS

FLAKE CATEGORY	RAW MATERIAL TYPE									
	Quartzite		Petrified Wood		Chert		Miscellaneous		Total	
PRIMARY CORTEX	47	66.19 3.17	11	15.49 3.50	5	7.04 4.80	8	11.26 13.33	71	100 3.62
SECONDARY CORTEX	174	84.46 11.74	17	8.25 5.41	4	1.94 3.84	11	5.33 18.33	206	100 10.51
LARGE SPALL	21	100 1.41	-	-	-	-	-	-	21	100 1.07
NON-CORTEX	180	80.0 12.15	25	11.11 7.96	15	6.66 14.42	5	2.22 8.33	225	100 11.48
BIFACE THINNING	36	100 2.43	-	-	-	-	-	-	36	100 1.83
RETOUCH/THINNING	436	84.16 29.43	37	7.14 11.78	39	7.52 37.50	6	1.15 10.0	518	100 26.44
BLOCK/SHATTER	154	38.98 10.39	199	50.37 63.37	20	5.06 19.23	22	5.56 36.66	395	100 20.16
BROKEN-PROXIMAL	433	88.91 29.23	25	5.13 7.96	21	4.31 20.19	8	1.64 13.33	487	100 24.85
TOTAL	1481	100 75.59	314	100 16.02	104	100 5.30	60	100 3.06	1959	100 100

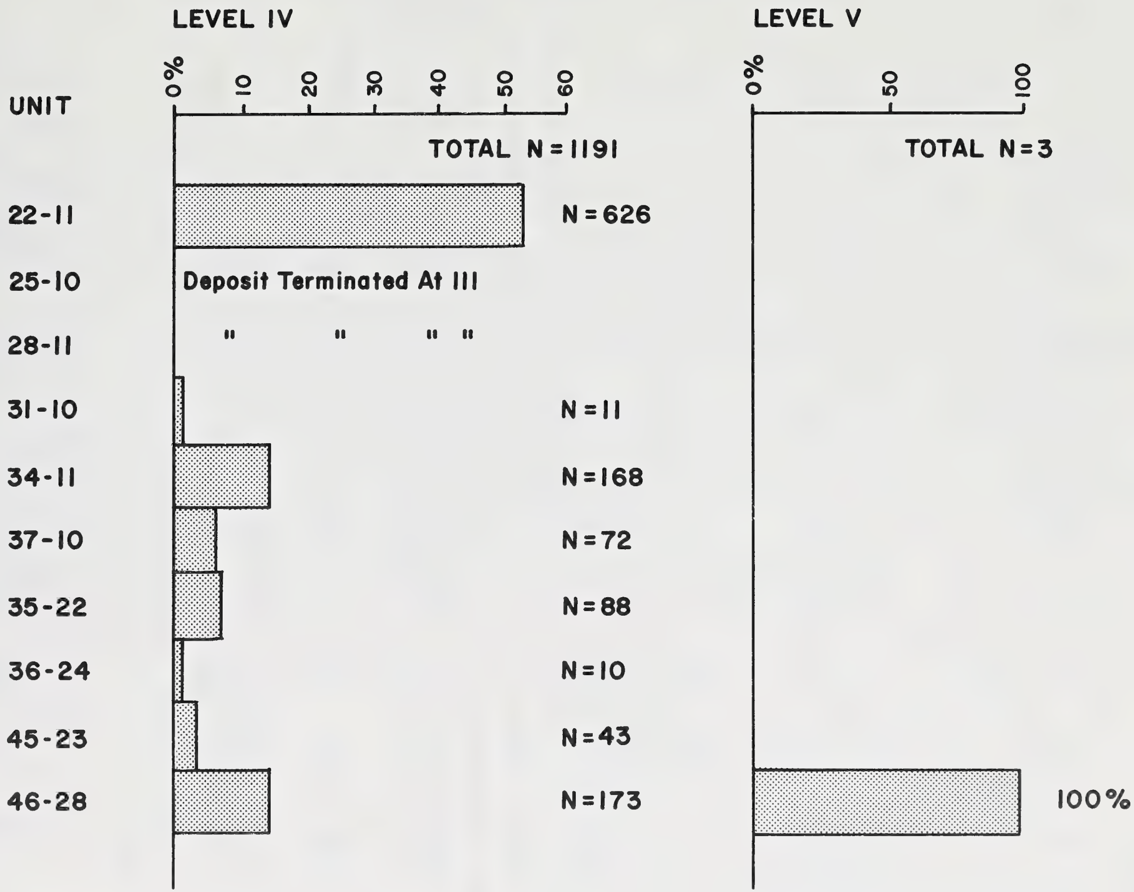
TABLE 24: DEBITAGE DISTRIBUTION BY UNIT

Flake Category	Unit 22-11		36-24		46-28		Total	
Primary Cortex	48	67.61 3.78	5	7.04 2.04	18	25.35 4.05	71	100 3.62
Secondary Cortex	133	64.56 10.47	18	8.74 7.35	55	26.70 12.39	206	100 10.51
Large Spall	16	76.19 1.26	3	14.29 1.29	2	9.52 .45	21	100 1.07
Non-Cortex	154	68.44 12.13	26	11.56 10.61	45	20.0 10.14	225	100 11.48
Biface Thinning	32	88.89 2.52	2	5.56 .82	2	5.56 .45	36	100 1.83
Retouch/Thinning	386	74.52 30.39	40	7.72 16.33	92	17.76 20.72	518	100 26.44
Block/Shatter	231	58.58 18.19	74	18.73 30.20	90	22.78 20.27	395	100 20.16
Broken Proximal	270	55.44 21.26	77	15.81 31.43	140	28.75 31.53	487	100 24.85
Total	1270	100 64.83	245	100 12.51	444	100 22.66	1959	100 100



TOTAL LITHIC PERCENTAGE FREQUENCY HISTOGRAM-BY UNIT-LEVEL.

FIGURE 11



TOTAL LITHIC PERCENTAGE FREQUENCY HISTOGRAM-BY UNIT-LEVEL.

FIGURE 11 (Continued)

unit. The artifacts recovered from unit 26-28 follow a pattern similar to that noted in unit 22-11, but to a lesser degree. Again, the distribution pattern suggests an area of fairly intensive reduction/manufacturing activity.

The debitage distribution by arbitrary level follows a similar pattern to that noted for other artifact categories. The major flake concentrations were found in levels 2, 3 and 4 (Table 25). Level 4 had the highest frequency of flakes (747-38.13%) followed closely by level 2 (633-32.31%). Level 3 had a slightly lower flake density of 480 or 24.50% of the total sample. All three levels contained a representative sample of each of the eight flake categories. Level 4 produced a somewhat higher percentage of biface thinning flakes than levels 2 and 3, while level 3 contained more large spalls than the other two major levels. These differences in frequency were not significant enough, however, to conclusively demonstrate technological variation between levels.

(e) <u>Inter-Site Comparison</u>

As previously stated the typology initially developed by Bucy and subsequently followed at least in part by Losey was used in the analysis of the debitage from FjPi-29. Losey correctly points out that one of the problems which persists in quarry studies is the absence of standardized typology which would permit inter-site comparison of data (Losey 1974:74). By following Bucy's basic typology this standard is provided, permitting comparison of the data from FjPi-29 to two major sites at least.

Table 26 presents a summary of the data from FjPi-29, Beaver Creek Quarry and the Midvale Quarry for the three basic flake categories common to each site. Losey, in comparing his data from Beaver Creek to Bucy's data from the Midvale Quarry, notes that:

> "..It is immediately apparent that there is a wide difference ...between the two sites. The Beaver Creek Quarry shows significantly smaller percentages of primary and secondary flakes than does the Midvale Quarry." (Losey 1974:75-76).

Losey suggests that this difference "...is related directly to the type of raw material used.", adding that

> "If one were to rely on the typology alone there is a

TABLE 25: DEBITAGE DISTRIBUTION BY ARBITRARY LEVEL-UNITS 22-11, 36-24, 46-28.

FLAKE CATEGORY	LEVEL 1		2		3		4		5		TOTAL	
PRIMARY CORTEX	2	2.81 2.08	12	16.90 1.89	32	45.07 6.66	25	35.21 3.34	-	-	71	100 3.62
SECONDARY CORTEX	9	4.36 9.37	51	24.75 8.05	70	33.98 14.58	76	36.89 10.17	-	-	206	100 10.51
LARGE SPALL	-	-	3	14.28 0.47	10	47.61 2.08	6	28.57 0.80	2	9.52 66.66	21	100 1.07
NON-CORTEX	11	4.88 11.45	72	32.0 11.37	75	33.33 15.62	67	29.77 8.96	-	-	225	100 11.48
BIFACE THINNING	-	-	5	13.88 0.78	12	33.33 2.50	19	52.77 2.54	-	-	36	100 1.83
RETOUCH/THINNING	16	3.08 16.66	192	37.06 30.33	54	10.42 11.25	255	49.22 34.13	1	0.19 33.33	518	100 26.44
BLOCK/SHATTER	30	7.59 31.25	150	37.97 23.69	94	23.79 19.58	121	30.63 16.19	-	-	395	100 20.16
BROKEN-PROXIMAL	28	5.74 29.16	148	30.39 23.38	133	27.31 27.70	178	36.55 23.82	-	-	487	100 24.85
TOTAL	96	100 4.90	633	100 32.31	480	100 24.50	747	100 38.13	3	100 0.15	1959	100 100

chance that such divergent outcomes could be misinterpreted as indicating technological differences." (Losey 1974:76).

From Table 26 it is apparent that the debitage frequencies at FjPi-29 very closely approximate those found at the Beaver Creek Quarry site. There are slight variations in the percentages of primary and secondary decortication flakes between the two sites but this variation is not significant. However, there is a major frequency variation between Midvale and the above two sites, which may in fact reflect "technological differences" between them.

TABLE 26: COMPARATIVE DEBITAGE DATA: FjPi-29, BEAVER CREEK QUARRY, MIDVALE QUARRY

Flake Category	Site					
	FjPi-29		Beaver Creek Quarry		Midvale Creek	
	No.	%	No.	%	No.	%
Primary Decortication	71	6.96	79	2.72	2.35	19.34
Secondary Decortication	206	20.19	708	24.38	742	61.06
Non-Cortex	743	72.84	2117	72.89	238	19.58
TOTAL	1020	100	2904	100	1215	100

As Losey pointed out, the primary raw material being reduced at the Midvale Quarry site consisted of irregular pieces of weathered basalt. Bucy notes that the cortex on alluvial materials "...is the result of literally thousdands of intersecting cones of force produced by battering and rolling in stream beds or other erosional situations." (Bucy 1971:10). Because of these cones of force, or "incipient fractures", Bucy suggests that "It is most difficult to produce well made tools or to exercise good control in the cortex zone of the material." (1971:10). Consequently, Bucy indicates that:

"The first step in using alluvial materials is the removal of all the cortex and shattered material, leaving the homogeneous material without flaws or cracks." (1971:11).

In essence then, the primary and secondary decortication flake types described by Bucy represent the initial flakes removed from the cobble expressly to expose the unaltered interior material subsequent to utilization of the cobble as a core.

At FjPi-29 the quartzite cobbles, which constitute the bulk of the raw material being reduced, were also alluvial in nature, possessing the "orange peel or goose flesh" cortex typical of naturally battered cobbles. In contrast to Bucy's findings at the Midvale Quarry the reduction technology at FjPi-29 emphasized splitting the cobble into usable pieces as the first stage of reduction rather than paring away the cortex to expose the cobble interior. As was indicated in the proceeding section of this report dealing with biface/uniface production, at least one facet of the industry involved the selection of the large spalls or cobble halves, produced when the cobbles were split, to serve as blanks for biface/uniface manufacture. The use of these cobble sections as preforms, negated the necessity of preparing the cobble by first removing all of the cortex. The cobble cortex adhering to these blanks was removed as a matter of course when the blanks were reduced to produce bifaces and unifaces. Consequently at least a portion of the flakes produced during biface manufacture were either fully or partially covered by cortex qualifying them as either primary or secondary decortication flakes under Bucy and Losey's typology. However, technologically the cortex covered flakes from FjPi-29 and those from the Midvale Quarry are the product of different reduction processes. Presumably the higher incidence of decortication flakes and lower incidence of non-cortex flakes at Midvale as compared to the reverse frequencies at FjPi-29 and Beaver Creek Quarry is a reflection of this difference in technological strategy.

SUMMARY REMARKS AND CONCLUSION

The archaeological results contained in this monograph have proved very rewarding. A great deal of data has been obtained pertaining to the eight basic problem orientated questions proposed in the introductory section of the report. Most of the questions we were able to answer positively, but predictably a number remain open pending further field research.

In regards to the first problem, based on the similarity of the debitage from FjPi-29 to that from both the Beaver Creek and Midvale Quarry sites, combined with reconstructed patterns of biface-uniface production, FjPi-29 has been interpreted as functioning primarily as a lithic workshop. However, the depth of the cultural deposit and the presence of sizeable quantitites of faunal remains suggests that the site was an occupied or inhabited workshop as opposed to a site visited for only short periods of time solely for the quarrying and initial reduction of lithic raw materials. In fact, in light of the types of debitage recovered during the 1978 field season, the possibility exists that major quarrying activities were conducted elsewhere, off-site, and selected pieces of raw material were transported back to the site for further reduction. This is a fresh problem area which will be considered during the 1979 field season.

As to the second question, the homogeneity of raw material types both vertically and horizontally across the site, the similarity of debitage types between excavated units and the presence of the same types of projectile points in the major levels of cultural deposition all point to a primarily single component occupation of the site. Again fieldwork in 1979 will serve to confirm or modify this observation.

Evidence gathered in regard to question three during the 1978 field season was not sufficient to provide answers about the processes involved in the selection of that particular area for occupation prehistorically. This problem area will be given further reconsideration in the coming field season.

In regards to question four, while there were obvious technological similarities between FjPi-29 and other sites on the Northwestern Plains, there is presently insufficient data either from this site or other sites of known cultural affiliation for unquestionable comparisons.

Questions five and six did provide some positive results on the basis of the artifact sample collected in 1978, augmented by experiments in cobble reduction and biface manufacture, we were able to reconstruct portions of the lithic reduction sequences at the site, specifically in the area of biface manufacture.

As well, a positive answer for problem seven was obtained. Using patterns of debitage and artifact concentrations combined with variations in frequency of the major raw material types, we were able to tentatively define two separate activity areas, one along the ravine the other towards the centre of the site. Excavations of the site in 1979 should help to confirm these observations and hopefully delineate other activity areas.

In regards to the final and most complex problem, the data recovered from FjPi-29 combined with data from a number of other area sites may permit the formulation of a number of hypothetical techno-traditions based on patterns of lithic utilization both in terms of types of raw material utilized and the technology involved in its processing. At this point in time however, there is not sufficient data available to make definitive statements regarding specific techno-traditions let alone patterns of regional development. But excavations at sites such as FjPi-29 will provide some baseline data necessary for initial conceptualization of the kind of further research necessary for development of the technological traditions concept.

The 1978 investigations at FjPi-29 have proven that this extremely large and undisturbed prehistoric archaeological site is of very great importance to our understanding of the regional prehistory of the Edmonton area. Not only is it extremely valuable for scientific research but as well, it offers unlimited opportunities for interpretation and public education. As such, the site should be preserved and protected as an essential component of the Strathcona Science Park.

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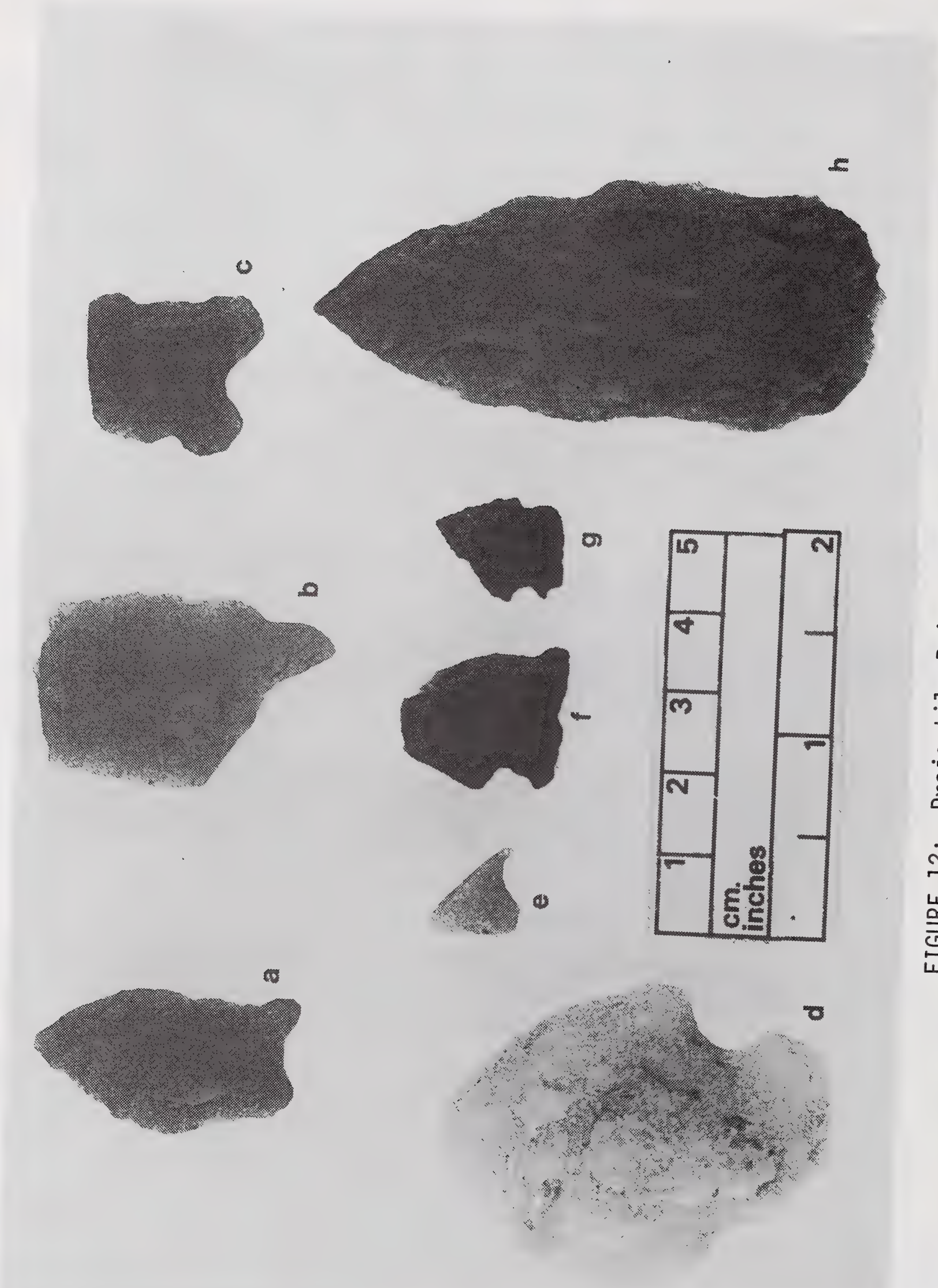

FIGURE 12: Projectile Points, Bifaces.

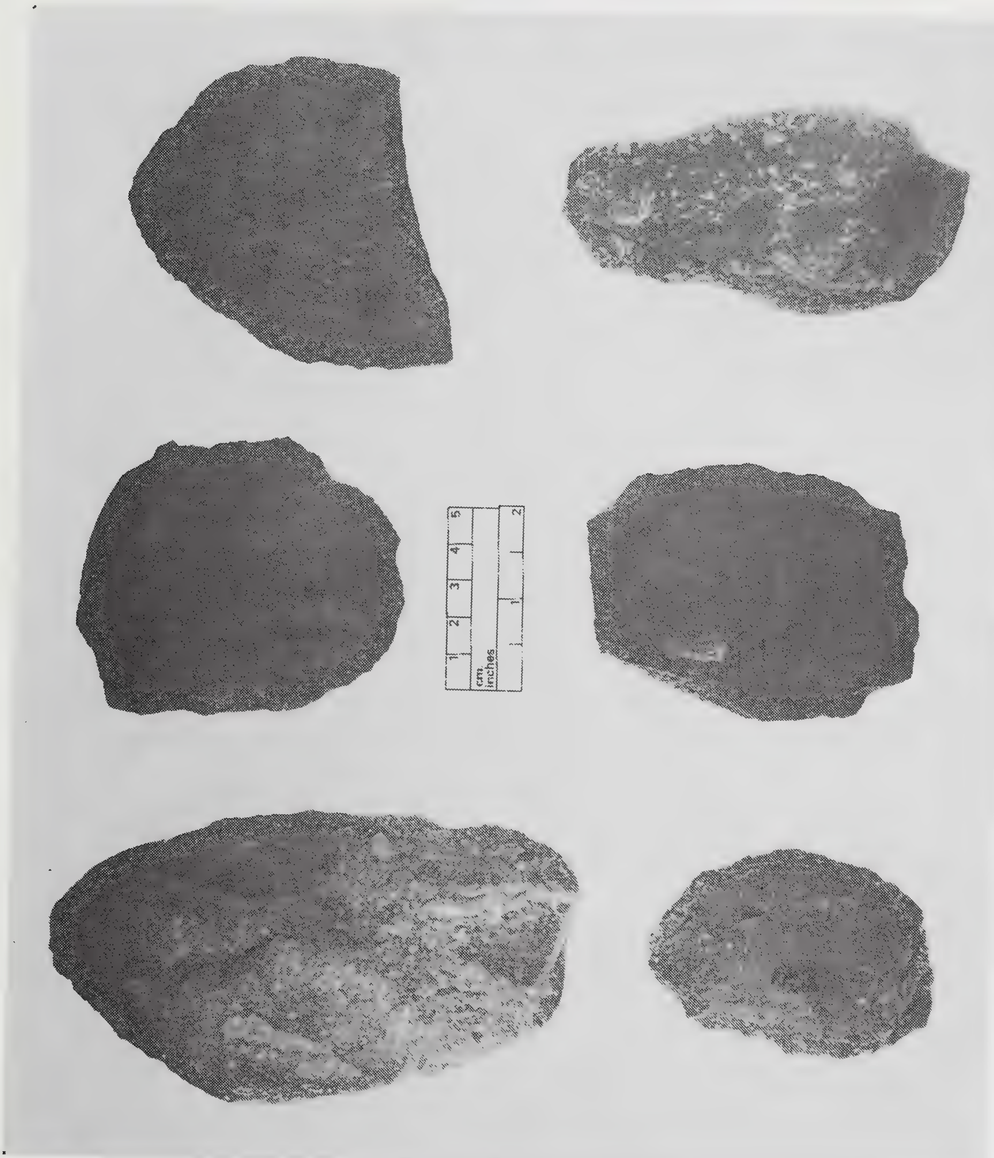

FIGURE 13: Biface, Uniface Preforms.

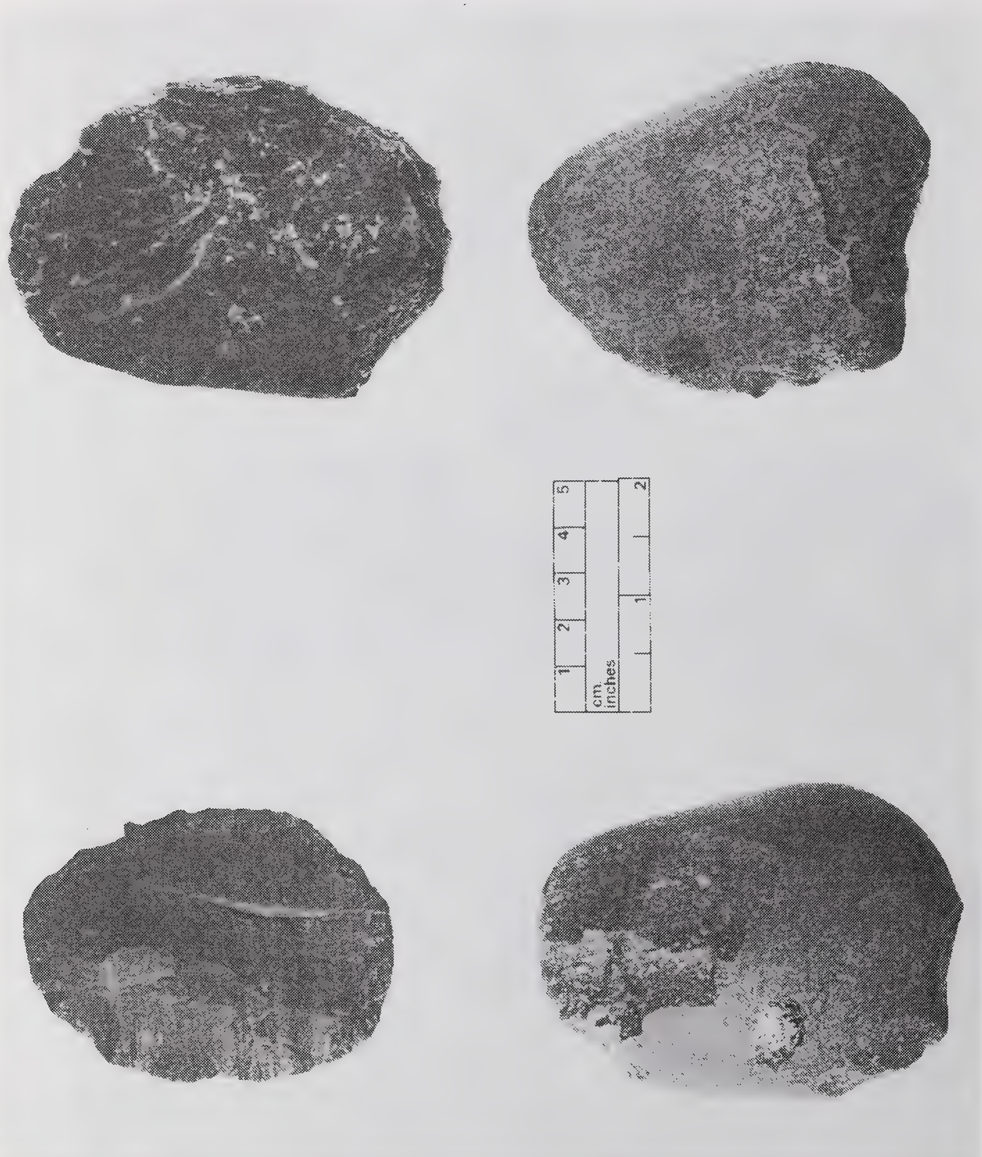

FIGURE 14: Flaked Cobbles and Cobble Spalls.

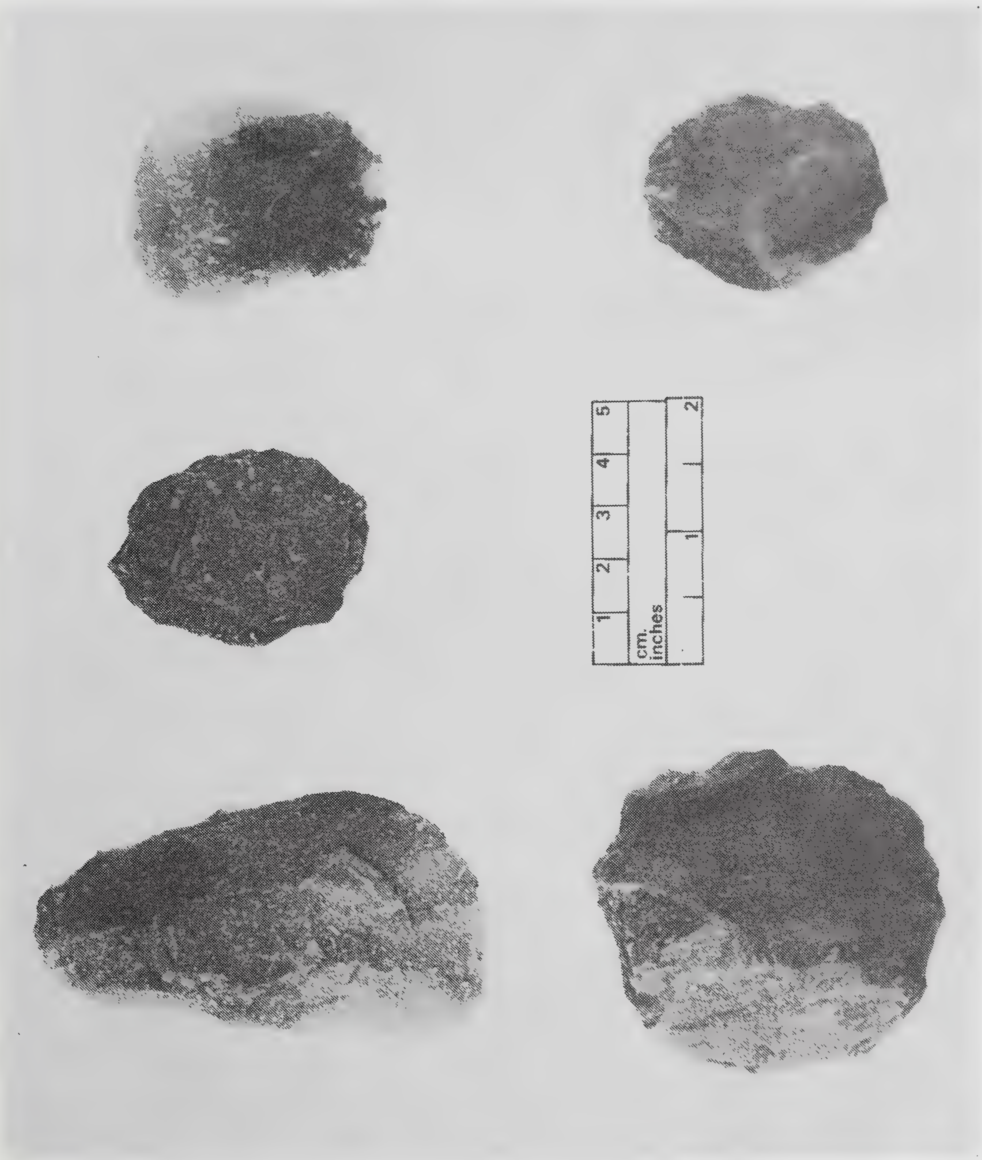

FIGURE 15: Quartzite Unifaces.

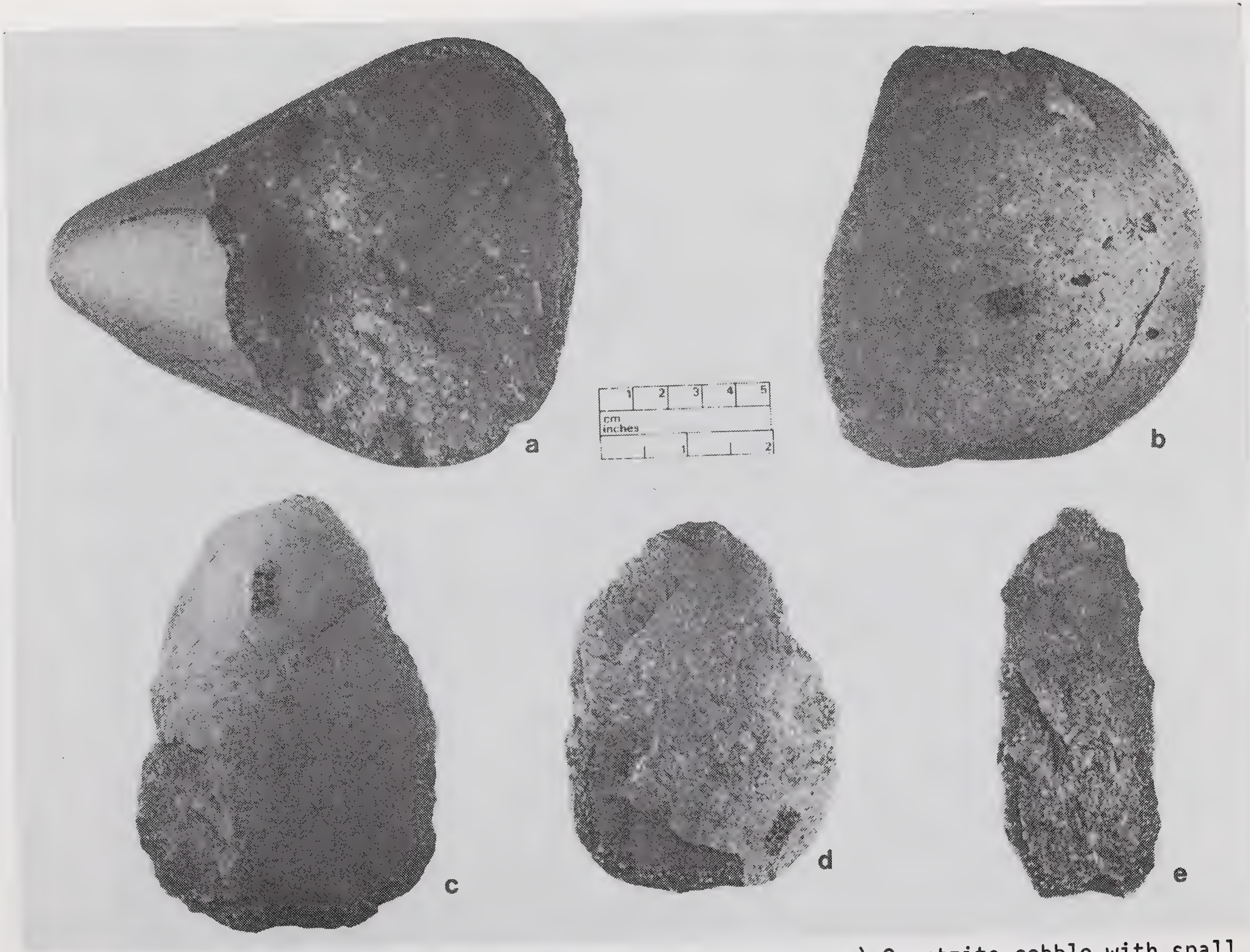

FIGURE 16: Cobble Reduction, Biface Manufacturing Sequence. a) Quartzite cobble with spall removed; b) Typical spall; c) Partially flaked spall blank; d) Biface preform with cobble cortex; e) Biface preform with cobble cortex removed.

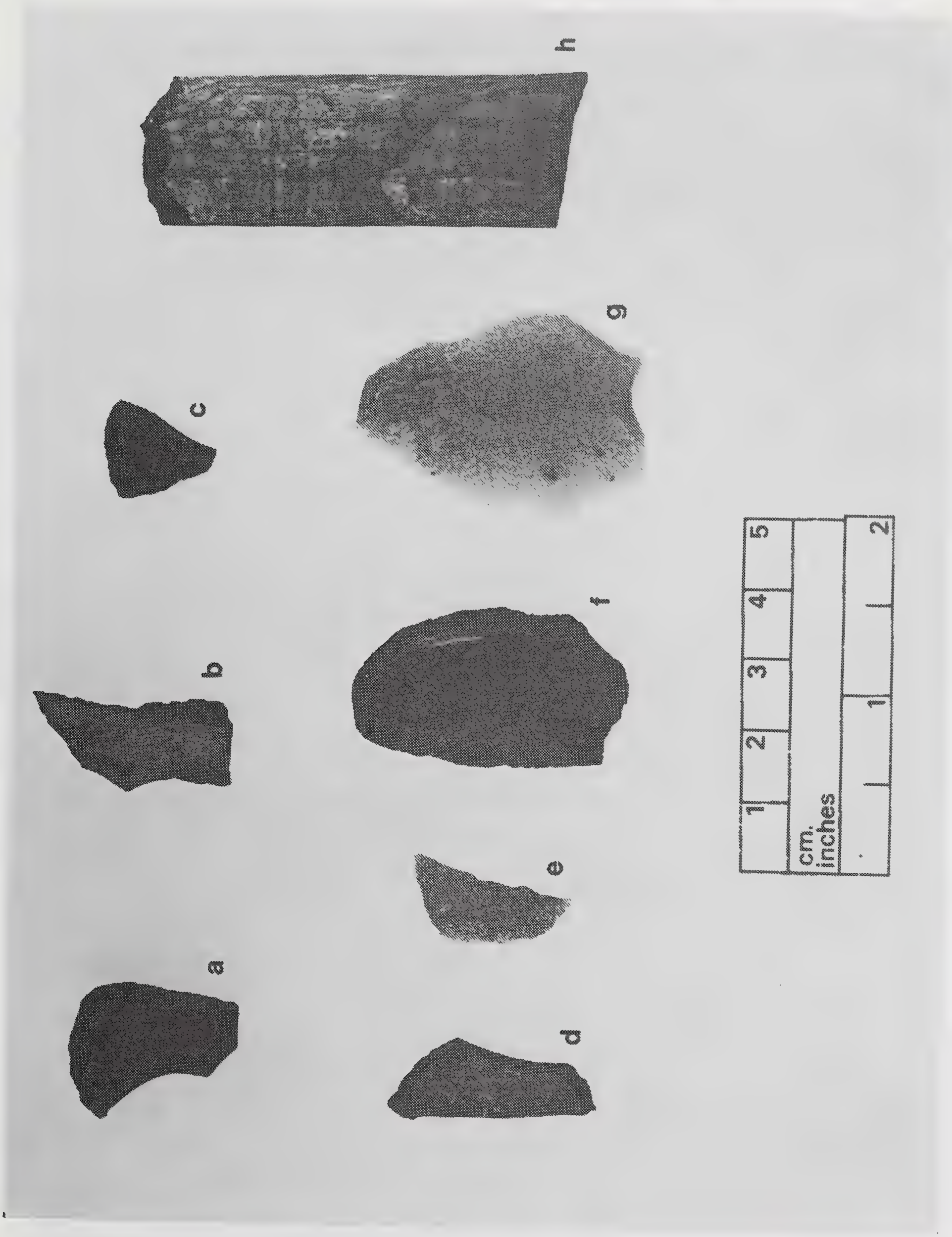

FIGURE 17: Scrapers.

FIGURE 18: Bipolar Cores and Flakes.

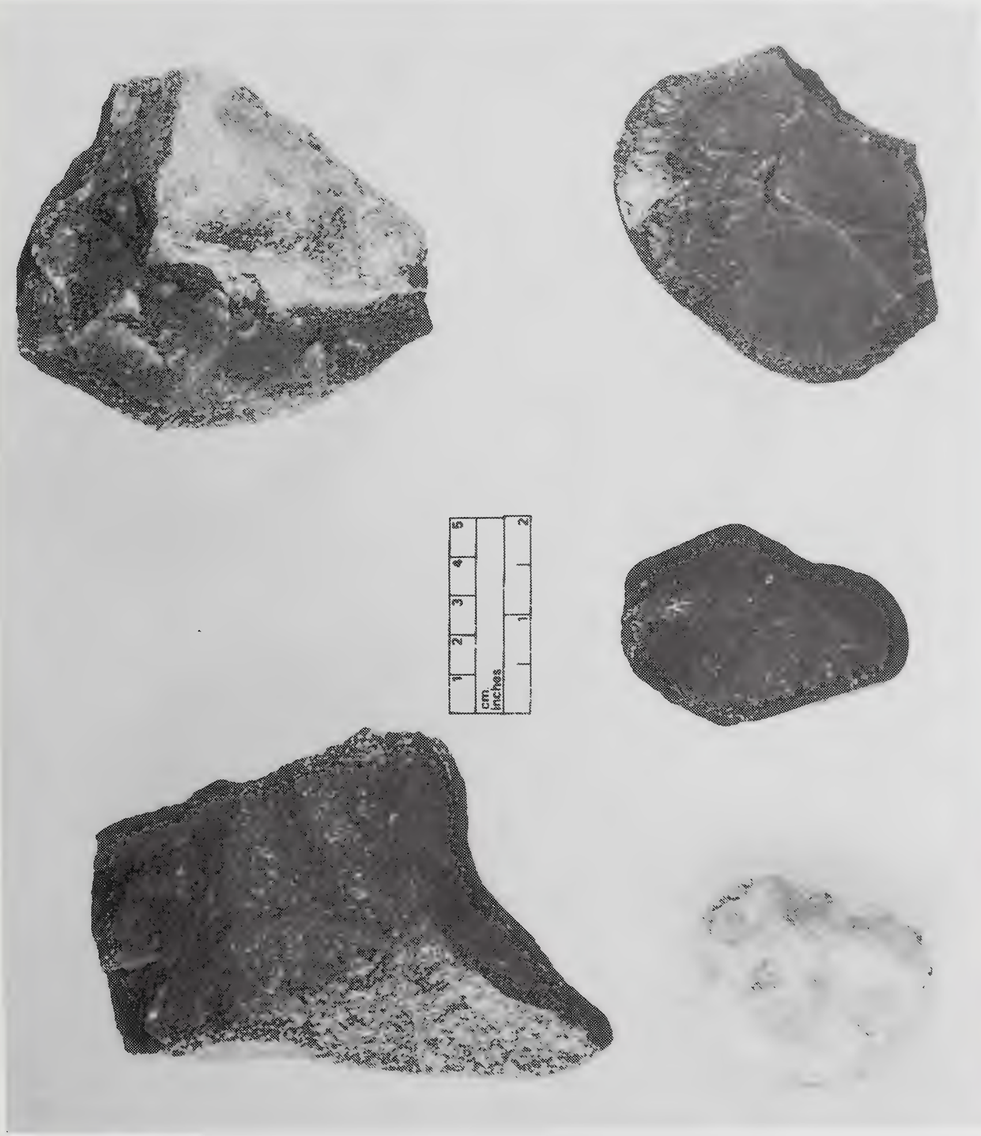

FIGURE 19: Cobble Cores, Split Cobbles.

FIGURE 20: Experimental Bipolar Reduction of a Petrified Wood Cobble - Partially Reconstructed Cobble Core.

FIGURE 21: Experimental Bipolar Reduction of a Petrified Wood Cobble-Disassembled Cobble Core.

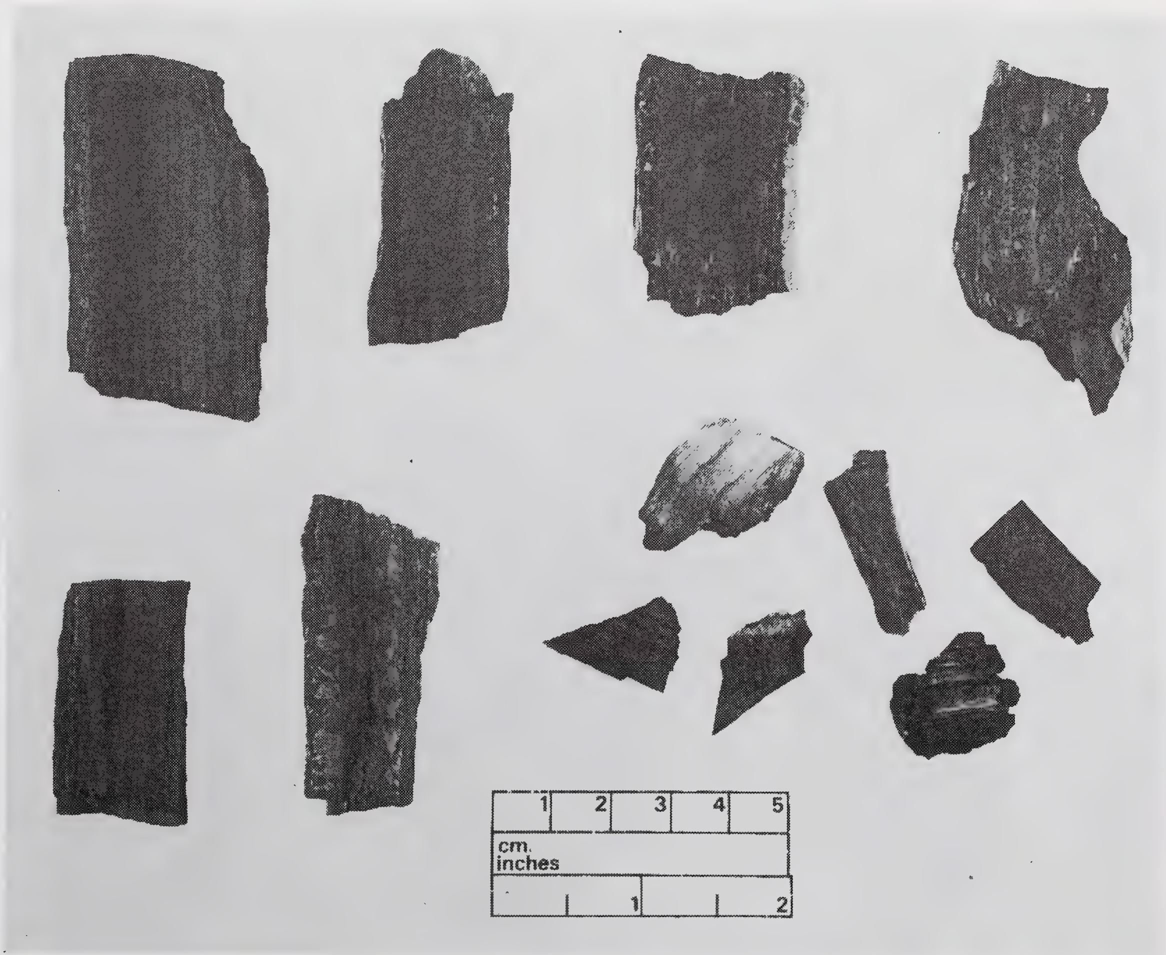

FIGURE 22: Comparative Petrified Wood Flakes and Cobble Fragments from FjPi-29.

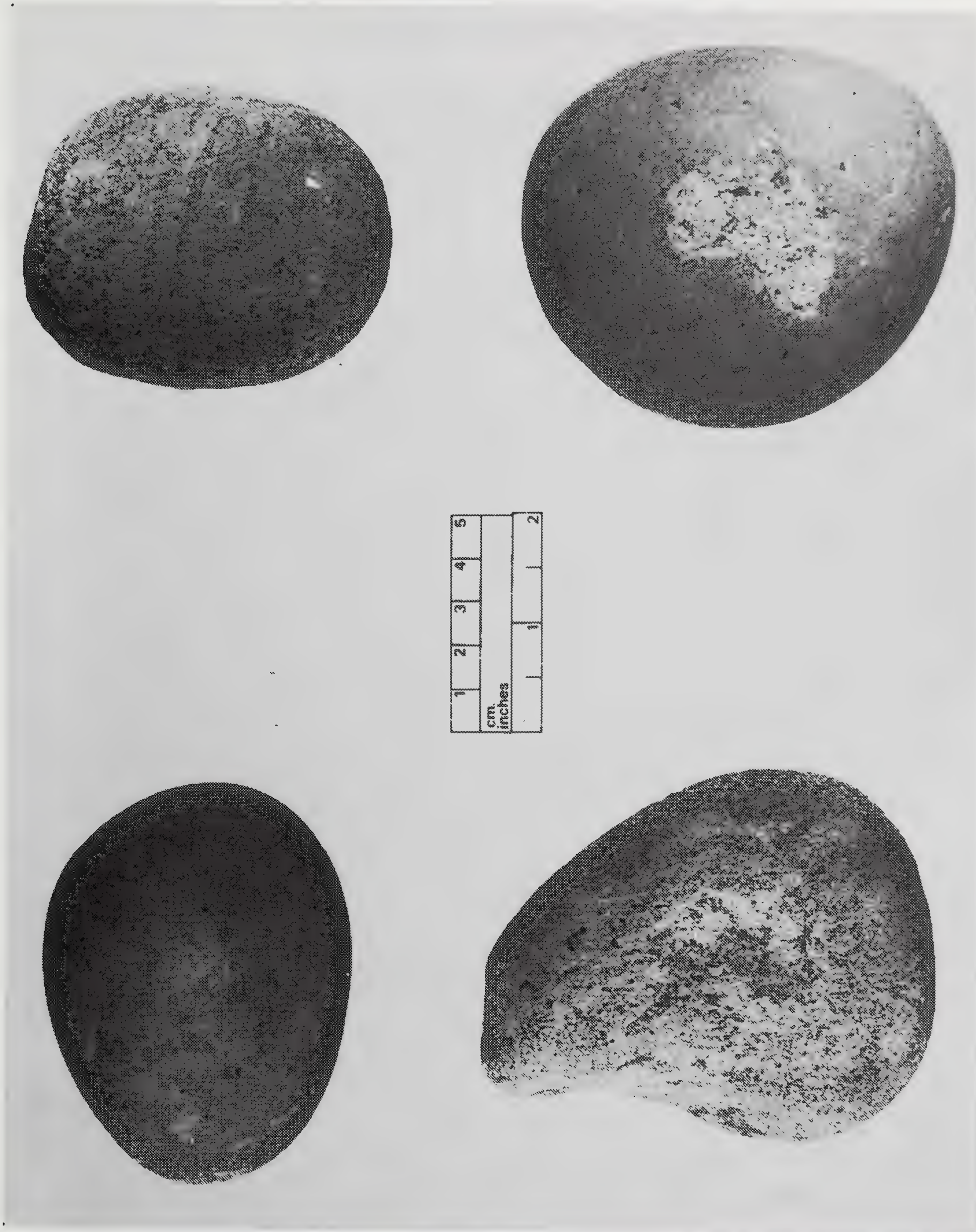

FIGURE 23: Hammer and Anvilstones.

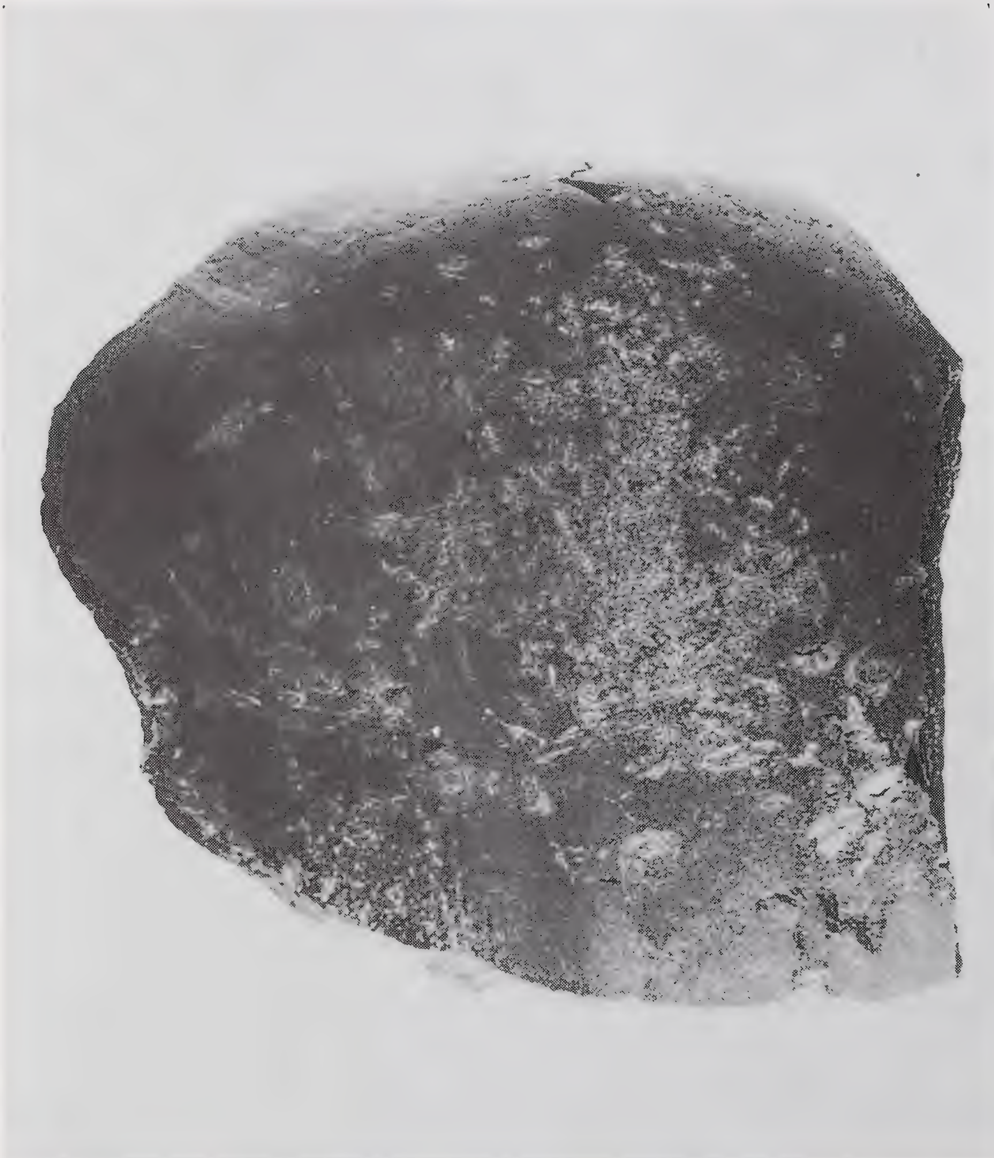

FIGURE 24: Large Quartzite Anvilstone, Showing Secondary Use as Cobble Core.

APPENDIX ONE
SITE SIZE AND DENSITY AS DETERMINED BY POWER AUGER SAMPLING

In order to obtain quick, uniform and replicable data for purposes of evaluating the density of artifactual material present in the site deposit as well as to confirm positively the limits of a site, a power auger was used to obtain standard 24-25 cm diameter test holes across the site along five surveyed lines (See Figure 2). Altogether some 112 auger holes were placed in the site to an average depth of 37.72 cm and a total of 157 specimens were recovered. This data is presented in the following tables arranged by individual survey lines as indicated on figure three of this report.

North South line "O" had no auger pits placed along it due to previous disturbance and is not included in this analysis.

All holes were randomly spaced in a horizontal distance from the datum point as indicated on the accompanying tables. Under better field conditions a uniform spacing of the auger holes is recommended. This was not possible at FjPi-29 due to dense vegetation and root masses.

The North South lines were spaced 20 metres apart, while the East West lines were spaced 14 and 16 metres apart respectively in order to avoid undercutting of vegetation. The sampling programme covered the majority of the 15,960 square metre sites excluding the partially disturbed area along the eastern boundary (Figure 3). These survey lines also served an alternative function as base lines for the excavation of 2x2 metre test excavation units.

As all of the auger holes were drilled through the topsoil layers to glacial till which was extremely resistant to the auger bit, the depths of each individual hole as well as the averages should be a reliable indicator of the maximum depth of cultural deposits to be expected throughout the site. An exception to this of course, would be features excavated deeper by the aboriginal inhabitants.

During future use of the auger we would recommend that a plastic

skirt with a collar hole be used during the field sample taking. Dirt from the auger would then collect in this skirt and could be bagged for laboratory process in the lab or field. This is because the rotary action of the auger causes flakes, etc. to become encased in lumps of soil. Although one may carefully trowel the auger "back dirt" we estimate that 20-30% of specimens will not be recovered.

APPENDIX ONE, TABLE A-1, Results of Auger Hole Testing (FjPi-29).
North South Line 1, Datum Base: N.W. Corner of Unit 35-10

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	3.8	40	One f.b.r.
2	9.2	33	
3	13.7	50	One quartzite flake, 1 f.b.r.
4	20.1	44	Two quartzite flakes
5	22.8	43	3 f.b.r., 2 quartzite flakes
6	25.25	50	2 f.b.r.
7	28.7	43	
8	32.3	34	3 pieces quartzite shatter,1 qtzte flake
9	35.5	36	2 quartzite flakes
10	38.8	42	1 quartzite flake
11	41.9	50	1 f.b.r.
12	44.65	40	

APPENDIX ONE, TABLE A-2, Results of Auger Hole Testing (FjPi-29)
North South Line 2, Datum Base: N.W. Corner of Unit 45-10

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	1.45	38.0	3 pieces f.b.r.
2	5.5	48.0	
3	6.95	45.0	
4	10.5	40.0	1 f.b.r.
5	13.15	38.0	1 quartzite flake
6	15.7	39.0	1 f.b.r.
7	18.85	46.0	
8	20.65	37.0	
9	23.55	45.0	
10	25.4	48.0	
11	29.4	47.0	
12	33.8	36.0	2 f.b.r.
13	37.1	30.0	2 large f.b.r.
14	40.7	30.2	
15	33.5	38.0	
16	46.6	46.0	2 pebbles
17	53.9	52.0	
18	57.0	36.0	

APPENDIX ONE, TABLE A-3, Results of Auger Hole Testing (FjPi-29)
North South Line 3, Datum Base: N.W. Corner of Unit 55-10

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	1.4	33	
2	4.5	44	1 piece f.b.r.
3	7.45	40	
4	10.0	52	1 flake petrified wood, 4 pcs. f.b.r.
5	12.55	48	3 pieces f.b.r.
6	15.0	37	1 piece f.b.r.
7	17.4	42	
8	19.9	40	
9	22.5	33	large flake
10	24.95	22	2 pieces f.b.r.
11	26.5	50	
12	30.0	22	
13	36.8	34	1 piece f.b.r.
14	40.3	23	1 piece f.b.r.
15	44.6	34	1 piece f.b.r.
16	47.65	25	1 piece f.b.r.
17	50.2	38	2 pieces f.b.r.
18	53.3	36	

APPENDIX ONE, TABLE A-3 (Continued)

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
19	56.35	24	
20	59.95	25	
21	62.8	30	
22	65.9	40	
23	70.2	30	
24	74.25	32	
25	78.6	36	
26	82.75	25	
27	87.15	27	
28	89.7	30	1 f.b.r.
29	93.32	33	
30	103.2	36*	

* Entirely in sterile clay.

APPENDIX ONE, TABLE A-4, Results of Auger Hole Testing (FjPi-29)
North South Line 4, Datum Base: N.W. Corner of Unit 65-10

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	1.8	40.0	2 quartzite flakes
2	3.85	38.0	4 quartzite flakes
3	5.8	25.0	1 pc. bone,2 large qtzte.flakes,1 f.b.r.
4	7.6	30.0	2 pcs. bone, 1 flake, 5 pcs. f.b.r.
5	9.4	38.0	2 quartzite flakes
6	11.25	30.0	
7	13.8	40.0	very large f.b.r.
8	17.25	42.0	1 quartzite flake
9	19.4	30.0	1 quartzite flake
10	21.15	27.0	1 f.b.r.
11	24.55	22.0	
12	26.65	30.0	1 piece f.b.r.
13	29.8	36.0	
14	32.35	29.0	2 flakes pet.wood, 2 quartzite flakes
15	34.7	24.0	
16	37.8	36.0	3 pieces f.b.r.
17	40.95	33.0	1 quartzite flake
18	43.9	27.0	

APPENDIX ONE, TABLE A-4 (Continued)

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
19	46.6	30.0	1 f.b.r.
20	50.8	31.0	
21	54.45	34.0	
22	58.5	29.0	
23	61.2	32.0	1 chert flake, 1 quartzite flake
24	64.5	37.0	
25	69.6	40.0	
26	72.0	27.0	
27	74.8	34.0	
28	79.0	30.0	1 quartzite flake, 1 chert flake
29	83.5	27.0	
30	87.4	30.0	

APPENDIX ONE, TABLE A-5, Results of Auger Hole Testing (FjPi-29)
East West Line B, Datum Base: N.W. corner of Unit 65-17

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	4.1	40	2 qtzte.flakes, 1 poss.core, 3 f.b.r.
2	6.55	25	3 f.b.r.
3	9.1	30	1 large f.b.r., 3 quartzite flakes
4	12.2	37	3 quartzite flakes, 3 f.b.r.
5	14.35	25	1 quartzite flake, 3 pcs. f.b.r.
6	17.2	23	1 qtzte.flake,7 f.b.r.and/or core shatter
7	20.9	23	2 quartzite flakes, 2 f.b.r.
8	24.2	35	2 pcs. bone,2 pcs. charcoal,2 pcs. f.b.r.
9	27.3	30	2 quartzite flakes
10	30.9	40	1 quartzite flakes, 2 small f.b.r.
11	33.5	34	1 flake pet.wood, 5 quartzite flakes
12	35.7	27	

APPENDIX ONE, TABLE A-6, Results of Auger Hole Testing (FjPi-29)
East West Line C, Datum Base: N.W. corner Unit 65-25

Auger Hole Number	Distance from Datum in Metres	Depth in Centimeters	Artifactual Material Recovered
1	3.0	38	2 large f.b.r.
2	5.9	30	1 large f.b.r.,1 qtzte.flake,poss.bone?
3	10.3	34	
4	13.8	40	1 core pet.wood, 1 flake, 1 f.b.r.
5	16.85	38	
6	21.5	42	
7	25.7	45	1 quartzite flake, 1 f.b.r., 1 pc.bark
8	30.9	60	1 quartzite cobble, unworked
9	34.5	30	2 quartzite flakes
10	37.5	52	1 quartzite flake

APPENDIX TWO
PRELIMINARY FAUNAL ANALYSIS (FjPi-29)

METHOD

The faunal sample from the 1978 excavations of FjPi-29 consisted of 1.9 kilograms of bone which was in a highly fragmented condition. The assemblage was divided into identifiable and unidentifiable categories, the former consisting of those bone elements that can be identified to genus or species (family in one case). The identifications were made using the comparative faunal collections of Dr. T. Losey, and the Zoology Museum, University of Alberta. Unidentifiable bone remains cannot be assigned to a specific animal group, although the element may be recognizable. Within each of these categories, the bones were grouped into more specific classes:

1. Large mammal, e.g. bison, deer, bear.
2. Small mammal, e.g. mouse, hare, beaver.
3. Bird.
4. Indeterminate mammal bone.
5. Indeterminate bone.

Indeterminate mammal bone includes those fragments which were only recognizable as mammal bone. The indeterminate bone class is comprised of small fragments which were undistinguishable as to mammal, bird, or fish.

Although bones were both weighed and counted, the weights form the basis of this analysis. Bone weights are recognized as a more accurate method of quantification (Chaplin 1971:65), because a particular element has a relatively constant weight within a species or size class, but can be broken into two or 100 pieces, depending on depositional or cultural factors. However, weights will always be biased toward the large mammal groups since these bones are heavier than small mammal, bird or fish remains. This bias must be kept in mind when examining faunal assemblage composition.

Since part of the sample was surface collected from a disturbed area along with historic artifacts, it was necessary to create a _Bos/Bison_ category for identified elements. These genera are difficult to distinguish, although in this case the remains recovered are likely _Bison_.

RESULTS

The relatively small faunal sample and poor bone preservation make any definite statements concerning game procurement and activity areas impossible at this time. The following discussion of the results is tentative and requires a larger sample before more concrete statements can be made. The faunal sample yielded few elements identifiable to taxon; of a total of 383 fragments, only 29 bones (7.6%) were identifiable (Table A.1). Bison remains were the most numerous, but no more than one individual animal can be suggested from these remains although it is likely that many more were utilized. Identified bone weights represent roughly 70% of the total sample (Table A.2), but this is largely because almost all identified bone was large mammal, therefore the weight bias noted previously is operational.

However, as Table A.3 shows, the predominance of large mammal bone (about 99%) is still greater than would be expected if the heavier nature of the bone were the only factor. An additional factor is lack of preservation; much of the unburned bone is highly weathered and fragmented. However, since some fragile bird bone is present, poor preservation cannot be the major factor. Therefore, the sample appears to indicate a hunting preference in favour of large game animals, mainly bison. Absence of fish remains may be due to lack of preservation, but selection against fish cannot be ruled out.

DISTRIBUTIONS

Examination of vertical distribution shows that level 3 (20-30 cm B.S.) contains the majority of bone in most units (Table A.2). Overall, level 3 from all units, totalling 482.6 g, contributes about 25%, second only to the surface collection (about 56%). Excluding the surface collection, level 3 contains over half of the remaining bone as well as the majority of identified bone elements (Table A.2).

No significant patterns are apparent in vertical or horizontal distributions of types of faunal groups (Table A.3). Large mammal remains occur in almost all levels of all units, while too few small mammal and bird remains were recovered to permit any concrete statements.

Grouping faunal remains from various units (excluding surface remains) showed no clear pattern of horizontal distribution (Table A.4); however unit 46-28 contains a substantially greater amount of bone than all other units. Comparably lower quantities were recovered from units 45-23 and 36-24, while the nearby unit 35-22 had the lowest bone frequencies. These results suggest an area of bone concentration which may be tentatively represented by Circle 1 in Figure A.1. The bone quantities represented in the remaining six units suggest a gradient of decreasing bone concentration along Line A as shown by Circle 2 in Figure A.1. These statements are tentative since the differences in quantities of bone among the ten units are not great.

BONE USE

There is no definite evidence of butchering, although some possible cut marks are present. These marks are represented on one humerus head fragment (unit 28-11, level 3); one bison astragalus (unit 31-10, level 2); one bison humerus shaft fragment (unit 46-28, level 3); two long bone shaft fragments in unit 46-28, levels 3 and 4. Gnawing of bones by carnivores is evident, and the results of this activity are often difficult to distinguish from some types of butchering marks; the problem is compounded by poor bone preservation. Furthermore, none of these marks is very clear, and the quantity of marks is certainly not large enough to allow formulation of butchering patterns.

A large proportion of this sample is highly fragmented. It is not possible to identify a human agent involved in bone fragmentation. In fact, it is more likely that this is due to natural bone desication, since most cracking is longitudinal.

No obvious pattern in distribution of burned and unburned bone is apparent (Table A.2). Burned bone occurs throughout the site, although comparatively little is present in the cluster of units 37-10, 34-11, 31-10, 28-11; most burned bone occurs in units 46-28 and 22-11.

Some possible indications of seasonal use are present. The presence of geese and ducks suggests an early spring to late fall occupation. From historic records (Losey 1977:78), it appears that moose and elk were most often taken in late fall. However from these data it is only possible to

state that the site was probably occupied in late fall, but it cannot be stated that it was not utilized at any other time of the year.

CONCLUSIONS

From the analysis of this small faunal assemblage, some potentially interesting trends are apparent, requiring further investigation. These have been briefly discussed above, and include evidence of horizontal and vertical distributional patterns in bone quantities as well as in location of burned vs. unburned bone. There is also some evidence of food selection of available resources in favour of large game and against fish.

This lack of variety in the animal remains, as well as the low overall bone to artifact ratio leads to the suggestion that this site was not a long term habitation site. Rather, it was most likely occupied for a short period(s), perhaps being used repeatedly over a number of years. Integration of additional archaeological and faunal research of this site, should shed light on this issue, as well as a number of other problems discussed here.

TABLE A.1 ELEMENT IDENTIFICATIONS

	Bison	Bos/Bison	Alces alces	Cervus elephas	Cervidae	Erethizon dorsatum	Anser albifrons	Anas acuta	Unidentifiable large mammal
Skull fragments	1								1
Mandible fragments									
Teeth: upper	3								
lower	1				1				7
Scapula	1								
Humerus	2						1	1	1
Radius/ulna	1								
Metacarpals	1	1							
Carpals		1							
Phalanges	5	1							
Femur							1		
Tibia	1			1					
Pelvis fragments	1								
Metatarsals									
Tarsals	2		1						
Metapodials						1			
Vertebrae fragments									2
Rib fragments									14
TOTALS	19	3	1	1	1	1	2	1	25

TABLE A.2 BONE WEIGHT AND BURNED/UNBURNED BONE DISTRIBUTIONS

Unit/Level	Identified Bone		Unidentified Bone		Total Bone Weights		Burned Bone		Unburned Bone	
	g.	%	g.	%	g.	%	#	%	#	%
22-11: 2	4.2	-	40.4	-	44.6	-	13	-	10	-
22-11: 3	9.2	-	19.7	-	28.6	-	9	-	18	-
22-11: 4	-	-	9.7	-	9.7	-	6	-	16	-
22-11: Total	13.4	0.98	69.8	11.7	83.2	4.3	28	16.9	44	20.3
25-10: 2	0	0	41.4	6.9	41.4	2.1	3	1.8	4	1.8
28-11: 1	-	-	4.3	-	4.3	-	-	-	4	-
28-11: 2	-	-	39.3	-	39.3	-	1	-	8	-
28-11: 3	-	-	20.4	-	20.4	-	-	-	8	-
28-11: 4	13.6	-	-	-	13.6	-	-	-	2	-
28-11: Total	13.6	1.0	64.0	10.7	77.6	4.0	1	0.6	22	10.1
31-10: 2	89.0	6.5	0	0	89.0	4.5	0	0	1	0.5
34-11: 2	41.3	-	1.8	0	43.1	-	-	-	7	-
34-11: 3	-	-	66.4	-	66.4	-	-	-	23	-
34-11: 4	-	-	0.8	-	0.8	-	3	-	-	-
34-11: Total	41.3	3.0	68.2	11.4	110.3	5.6	3	1.8	30	13.8
35-22: 2	-	-	0.4	-	0.4	-	1	-	-	-
35-22: 4	-	-	15.0	-	15.0	-	-	-	16	-
35-22: Total	0	0	15.4	2.6	15.4	0.79	1	0.6	16	7.4
36-24: 3	75.3	5.5	13.8	2.3	89.1	4.6	0	0	14	6.5
37-10: 2	-	-	8.7	-	8.7	-	-	-	2	-
37-10: 3	65.3	-	8.9	-	74.2	-	-	-	19	-
37-10: 4	-	-	0.3	-	0.3	-	1	-	-	-
37-10: Total	65.3	4.8	17.9	3.0	83.2	4.3	1	0.6	21	9.7
45-23: 1	-	-	5.0	-	5.0	-	1	-	-	-
45-23: 2	-	-	14.8	-	14.8	-	7	-	-	-
45-23: 3	76.0	-	2.3	-	78.3	-	1	-	3	-
45-23: Total	76.0	5.6	22.1	3.7	98.1	5.0	9	5.4	3	1.4

TABLE A.2 (Continued)....

Unit/Level	Identified Bone		Unidentified Bone		Total Bone Weights		Burned Bone		Unburned Bone	
	g.	%	g.	%	g.	%	#	%	#	%
46-28: 2	-	-	4.2	-	4.2	-	10	-	-	-
46-28: 3	116.6	-	8.7	-	125.3	-	26	-	1	-
46-28: 4	-	-	19.5	-	19.5	-	9	-	8	-
46-28: Total	116.6	8.6	32.4	5.4	149.0	7.6	45	4.1	9	4.1
T.P. Line 2	-	-	1.4	-	1.4	-	-	-	5	-
T.P. Line 3	-	-	2.2	-	2.2	-	2	-	-	-
T.P. Line 4	-	-	30.2	-	30.2	-	1	-	2	-
T.P. Total	0	0	33.8	5.7	33.8	1.7	3	1.8	7	3.2
Surface	869.3	63.9	217.2	36.4	1086.5	55.5	72	43.4	46	21.2
GRAND TOTALS	1359.8	69.5*	596.8	30.5*	1956.6	100.0*	166	43.3*	217	56.7

* These percentages relate to grand totals only.

TABLE A.3 DISTRIBUTIONS OF BONE CLASSES BY WEIGHT

Unit/Level	Large Mammal		Small Mammal		Bird		Indeterminate Mammal		Indeterminate Bone	
	g.	%	g.	%	g.	%	g.	%	g.	%
22-11: 2	43.4	-	1.2	-	-	-	-	-	-	-
22-11: 3	27.3	-	0.6	-	-	-	1.0	-	-	-
22-11: 4	8.1	-	-	-	-	-	1.6	-	-	-
22-11: Total	78.8	4.1	1.8	32.7	0	0	2.6	24.5	0	0
25-10: 2	40.9	2.1	0	0	0	0	0	0	0.5	62.5
28-11: 1	4.3	-	-	-	-	-	-	-	-	-
28-11: 2	38.9	-	0.4	-	-	-	-	-	-	-
28-11: 3	20.4	-	-	-	-	-	-	-	-	-
28-11: 4	13.6	-	-	-	-	-	-	-	-	-
28-11: Total	77.2	4.0	0.4	7.3	0	0	0	0	0	0
31-10: 2	89.0	4.6	0	0	0	0	0	0	0	0
34-11: 2	41.8	-	-	-	1.3	-	-	-	-	-
34-11: 3	65.2	-	-	-	-	-	1.2	-	-	-
34-11: 4	-	-	-	-	-	-	0.8	-	-	-
34-11: Total	107.0	5.5	0	0	1.3	16.2	2.0	18.9	0	0
35-22: 2	-	-	0.4	-	-	-	-	-	-	-
35-22: 4	15.0	-	-	-	-	-	-	-	-	-
35-22: Total	15.0	.78	0.4	7.3	0	0	0	0	0	0
36-24: 3	88.7	4.6	0	0	0	0	0.4	3.8	0	0
37-10: 2	8.7	-	-	-	-	-	-	-	-	-
37-10: 3	74.2	-	-	-	-	-	-	-	-	-
37-10: 4	-	-	0.3	-	-	-	-	-	-	-
37-10: Total	82.9	4.3	0.3	5.5	0	0	0	0	0	0

TABLE A.3 (Continued)....

Unit/Level	Large Mammal		Small Mammal		Bird		Indeterminate Mammal		Indeterminate Bone	
	g.	%	g.	%	g.	%	g.	%	g.	%
45-23: 1	5.0	-	-	-	-	-	-	-	-	-
45-23: 2	15.0	-	0.5	-	-	-	-	-	0.3	-
45-23: 3	78.3	-	-	-	-	-	-	-	-	-
45-23: Total	97.3	5.0	0.5	9.1	0	0	0	0	0.3	37.5
46-28: 2	2.8	-	0.3	-	-	-	1.1	-	-	-
46-28: 3	124.6	-	0.5	-	-	-	0.2	-	-	-
46-28: 4	18.3	-	0.5	-	-	-	0.7	-	-	-
46-28: Total	145.7	7.5	1.3	23.6	0	0	2.0	18.9	0	0
T.P. Line 2	-	-	-	-	-	-	1.4	-	-	-
T.P. Line 3	-	-	-	-	-	-	2.2	-	-	-
T.P. Line 4	30.2	-	-	-	-	-	-	-	-	-
T.P. Total	30.2	1.6	0	0	0	0	3.6	34.0	0	0
Surface	1079.0	55.9	0.8	14.5	6.7	83.8	0	0	0	0
GRAND TOTALS	1931.7	98.7*	5.5	0.28*	8.0	0.41*	10.6	0.54*	0.8	0.04*

* These percentages relate to grand totals only.

TABLE A.4 AREA DISTRIBUTIONS OF BONE BY WEIGHT (IN GRAMS).

Unit	Total Bone Weight	Large Mammal	Small Mammal
34-11	110.3	107.0	0
37-10	83.2	82.9	0.3
Total	193.5	189.9	0.3
22-11	83.2	78.8	1.8
25-10	41.4	40.9	0
Total	124.6	119.7	1.8
28-11	77.6	77.2	0.4
31-10	89.0	89.0	0
Total	166.6	166.2	0.4
GRAND TOTAL	484.7	475.8	2.5

Unit	Total Bone Weight	Large Mammal	Small Mammal
46-28	149.0	145.7	1.3
45-23	98.1	97.3	0.5
Total	247.1	243.0	1.8
36-24	89.1	88.7	0
35-22	15.4	15.0	0.4
	104.5	103.7	0.4
GRAND TOTAL	351.6	346.7	2.2

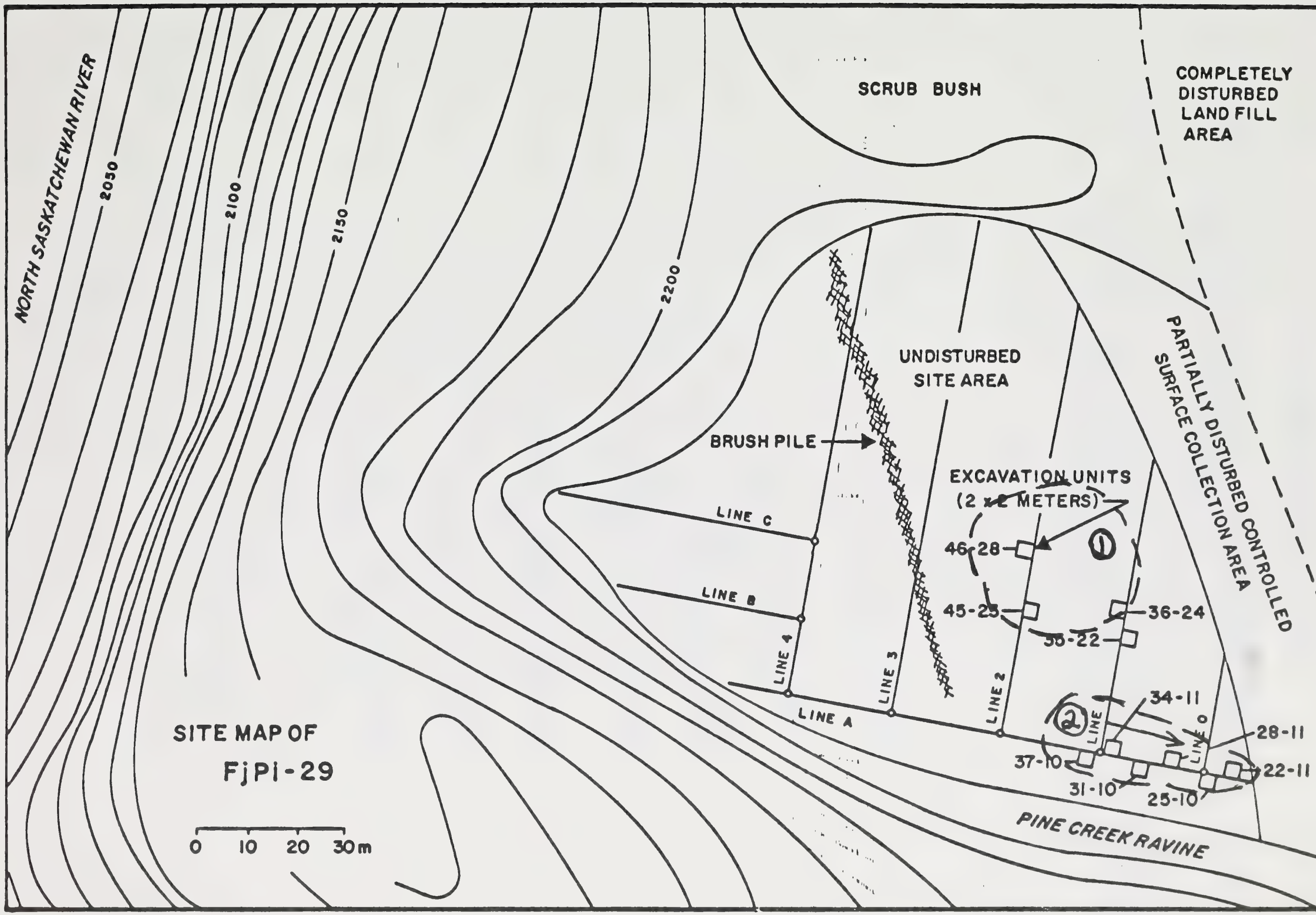

Figure A.1 Site map showing areas of bone concentration.

TABLE A.5 SPECIES DISTRIBUTIONS

<u>Bison bison</u> (bison

Unit 22-11, Level 2
Unit 28-11, Level 4
Unit 31-10, Level 2
Unit 34-11, Level 2
Unit 36-24, Level 3
Unit 37-10, Level 3
Unit 45-23, Level 3
Unit 46-28, Level 3
Surface Collection

<u>Bos/Bison</u> (cow or bison)

Surface Collection

<u>Alces alces</u> (moose)

Unit 22-11, Level 3

<u>Cervus elephas</u> (elk)

Unit 46-28, Level 3

Cervidae (cervid family)

Unit 46-28, Level 3

<u>Erethizon dorsatum</u> (porcupine)

Unit 22-11, Level 2

<u>Anser albifrons</u> (white-fronted goose)

Surface Collection

<u>Anas acuta</u> (pintail duck)

Unit 34-11, Level 2

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THE RESULTS OF MITIGATIVE EXCAVATIONS
DURING THE FALL OF 1979, STRATHCONA
SCIENCE PARK ARCHAEOLOGICAL SITE
(FjPi-29)

By
John W. Ives

Final Report
Permit No. 79-109

Excavations Conducted by the Archaeological
Survey of Alberta, Historical Resources
Division, Alberta Culture

November, 1980

PREFACE

The research upon which this report is based is already over five years old, so that several comments are merited. I had two objectives in structuring the manuscript as it is. Practically speaking, the permits of 1979 excavations at the site required a clear presentation of data and analysis. More generally, I hoped to set a different trend in the study of workshop and quarry kinds of sites.

In the small literature which existed at the time (much of it two to three decades old, or more), an inward focus for such sites was common. Workshops and quarries were seen simply as huge repositories of detailed technological information. The debitage analysis and concluding sections represented an attempt to look outward from FjPi-29 in order to see what, if any, logical connections existed between it and other Parkland sites. This exercise also served to integrate a growing body of otherwise isolated cultural resource management studies, particularly for subdivisions in the Edmonton area.

The last sections of the manuscript, then, were a small scale exploration for the problem of how raw stone materials circulated through entire technological systems. They were the product of frankly speculative, incipient thinking designed to stimulate further research. I refer to work in progress on Strathcona Science Park site collections at several points. This research will likely have to await the work of others, since my own interest in this larger technological problem has shifted to the Beaver River Sandstone sources in the Fort McMurray area of northeastern Alberta.

John W. Ives
Archaeological Survey of Alberta
Edmonton, 1985

ACKNOWLEDGEMENTS

Several poeple associated with the construction of the Strathcona Science Park went out of their way to provide myself and my crew with valuable assistance. In this regard, I would like to thank Richard, the Wells Foreman for his consideration, as well as the crew of Plumb Construction. Mr. Nick Sneptycki, an amateur who has collected in the area, freely made available his collection and knowledge of the area. Thanks also to Mr. Bruce Devlin for the opportunity to analyze his collection.

Various persons at the University have also provided timely advice. Dr. Steve Pawluk provided a commentary on the soils present at the site, while Pam Waters, Norm Cato and Dr. Nat Rutter have each helped with the geological interpretation. I would also like to thank my colleagues at the Archaeological Survey of Alberta, Michael Quigg, Ray LeBlanc and Dr. William J. Byrne for advice on the materials recovered.

Barry Newton helped to familiarize me with past years' work at the site, for which I thank him. Tom Andrews, Karin Koons, Gerhardt Maier, Susan Minogue, John Moir, Dave Porter and Nick Todd worked on various stages of the fieldwork. Bill Cottle, Bob Dawe, Kathy Fisher, Karie Hardie, James Young and Wes Zwicker worked on the laboratory analysis. My thanks to Wendy Johnson for all the drafting. I would especially like to thank Karie Hardie for assisting me through the difficulties of excavating the site and subsequent phases of analysis. Bob Dawe worked particularly hard in making an effective analysis of the debitage sample, the results of which have laid the groundwork for future research on the 1979 collections. Barbara King has generously provided editorial assistance.

In this report, I have tried to make as clear as possible the investigations carried out during the course of Permit Number 79-109. It is intended principally as a working document for those who will continue work at the site. A number of the results present here are obviously of highly tentative nature, particularly when extrapolated to statements about the entire site.

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I. INTRODUCTION

Located on the eastern outskirts of Edmonton, the Strathcona Science Park Archaeological Site (FjPi-29) has been the scene of archaeological testing and excavation over the last five years (Figure 1). By June of 1979, the site was slated for interpretive development within the Strathcona Science Park programme. Plans included a building housing static displays and providing on-site laboratory facilities. Associated development involved site fencing, a series of movable boardwalks joining interpretive nodes and an observation deck, as well as paved gate areas and bicycle paths. Each of these features would result in subsurface disturbance from construction activities (Figures 26, 27). The site required protection from this impact.

To this end, John W. Ives of the Archaeological Survey of Alberta began a series of mitigative excavations in August of 1979, with fieldwork continuing through mid-October of that year. During this period an additional 120 square metres of the site were excavated. This total is comprised of test 2 x 2 metre units, one metre trenching and larger excavation units in the observation deck and exit gate areas (respectively, 2 x 4 metres, 4 x 4 and 8 x 8 metres). This report documents the results of these excavations as well as describing work carried out under Permit Number 79-41 held by John W. Pollock. Mr. Pollock conducted limited excavations at FjPi-29 during the first portion of the 1979 field season.

Nearly 25,000 artifacts have been recovered from the site in the last five years, with over two-thirds of that total being discovered during the later phase of the 1979 excavations. Tremendous quantities of debitage and shatter attest to the site's function as a lithic workshop. Quartzite cobbles, which must have been retrieved from the Saskatchewan Sands and gravels formation, in the North Saskatchewan River Valley, were reduced to tools and tool preforms at the site.

Consequently, quartzite debitage completely dominates in the assemblage, although minor amounts of petrified wood, chert, chalcedony and obsidian were noted. The presence of faunal remains and fire broken rock do suggest that somewhat longer periods of habitation likely occurred at this site. Bone apatite and bone collagen radiocarbon dates indicate occupations of the site at ca. 370 B.P. and ca. 2100 B.P. (Ives and Newton 1980). Projectile points recovered by amateurs and professionals include Oxbow, McKean Complex, Pelican Lake, Besant and Late Plains styles. A fragment of South Saskatchewan Basin Complex pottery implies occupation at some point during the last millenium.

The analytical section of this report focuses upon a 25% sample of debitage drawn from the exit gate excavations. Along with other artifact descriptions, this sample was analyzed in an attempt to provide a clearer impression of the lithic technology enacted at the site over the last four to five thousand years. A spatial analysis of artifacts recovered from the exit gate area was also undertaken. This had special reference to the problems engendered by the apparent lack of stratigraphic separation between components at FjPi-29. It is quite likely that temporal problems at the site may be best approached by studying non-random spatial aggregates of debitage. The problem of the relationship of this workshop site with other kinds of sites in the Edmonton area is approached by examining the relationship between lithic procurement and other economic activities.

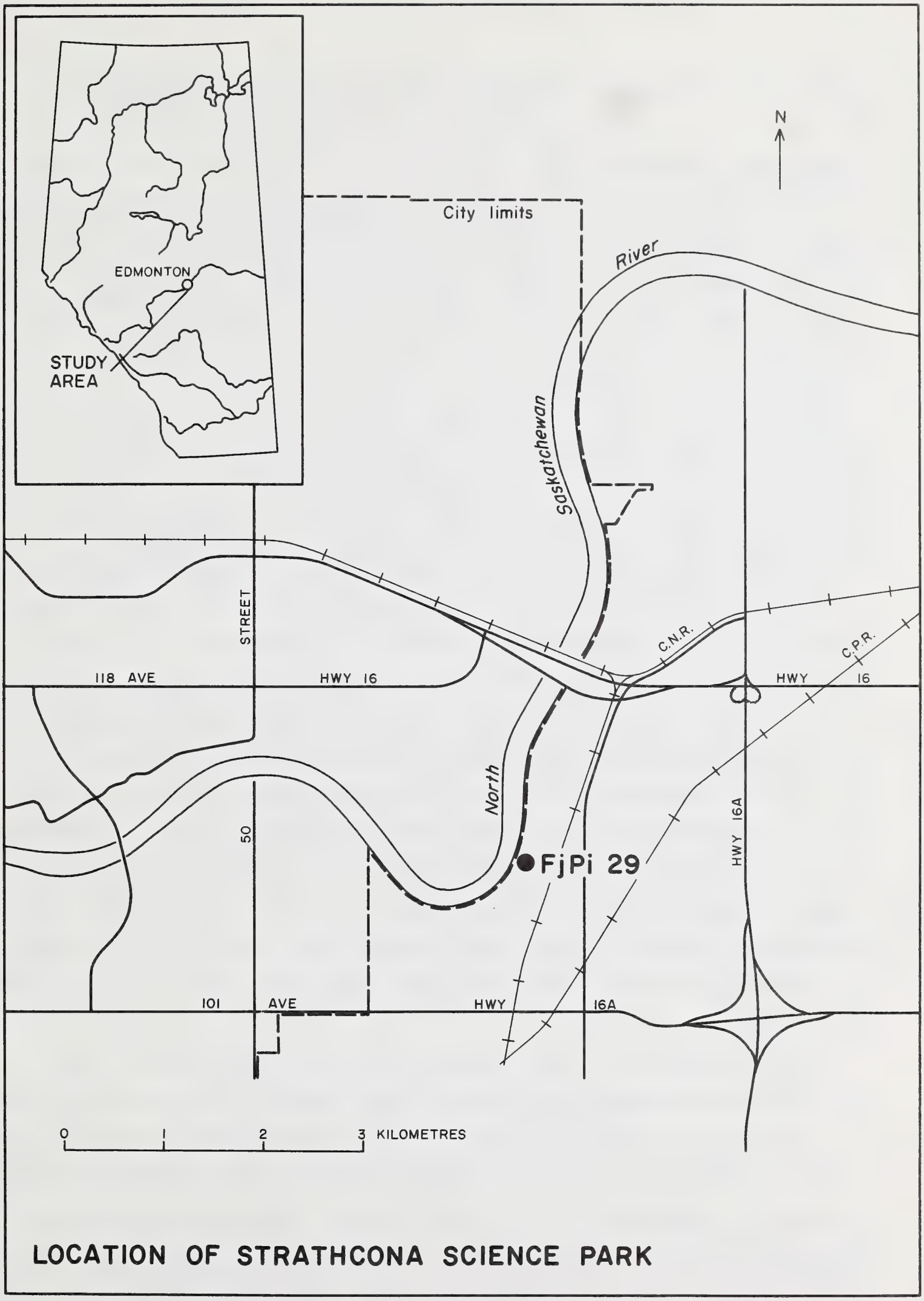

Figure 1: Situation of the Strathcona Science Park Archaeological Site (FjPi-29) on the outskirts of Edmonton, Alberta.

II. EXCAVATION: BACKGROUND, METHODS AND RATIONALE

History of Investigation

The precise spatial extent of the Strathcona Science Park Archaeological Site is difficult to fix inasmuch as the location was for years the scene of sanitary landfill activities. Although the site was first officially recorded by Aresco Ltd. in 1976, it had been known to amateurs in the City of Edmonton and district for some time. Mr. Val Diederich likely collected from various portions of the site for several decades before the recent investigations began (Thelma Habgood, personal communication). Just where this collecting might have taken place is somewhat less clear; it should be noted that a field immediately east of the Strathcona Science Park development (east of the railway tracks and south of the Alchem plant) is currently being collected by amateurs such as Mr. Nick Sheptycki of Edmonton. Mr. Sheptycki (personal communication) informs me that deep tillage of this field occurred only recently. Numerous bifaces and other artifacts are present. While the following discussion will focus upon the area fenced as FjPi-29 and environs, it is well to remember that this is probably only a narrow strip of the former site. The entire site doubtlessly ran along the bank of the North Saskatchewan and extended under the present land fill and landscaped areas, probably as far as the field referred to above. While roughly 10,000 square metres of site have been fenced, original site extent was quite conceivably on the order of 500,000 square metres.

Aresco personnel first located the site in the fall of 1976 as part of an archaeological survey for the Capital City Recreation Park area downstream of the High Level bridge. Work in May of the succeeding year suggested that the site had good scientific and interpretive potential. Subsequently, Mr. John Pollock, then of the Archaeological Survey of Alberta, undertook exploratory investigations during the 1978 field season. A report produced at that time concluded that the site

was a single component Oxbow Complex lithic workshop (Pollock and Newton n.d.). Site extent was defined by an augering program, while controlled surface pickup within 10 x 10 metre squares was conducted at the south-west end of the site. The authors reached the conclusion that FjPi-29 was a single component Oxbow site on the grounds of typological comparisons of projectile points and a cluster analysis of raw material usage within ten 2 x 2 metre excavation units placed along the edge of the terrace on which the site is located. The similarity of raw material usage in these units led the authors to conclude that the site had been used only during Oxbow times. By the early summer of 1979, Newton and Pollock's renewed excavations had revealed a multicomponent occupation of the site. This information influenced subsequent activities in 1979. Contract excavations for the 1980 interpretive season have been carried out since that time and a report on this work is forthcoming.

Excavation Techniques

In the first phase of excavations in 1979 carried out by Newton and Pollock, excavation was initiated on eleven 2 x 2 metre units. Of this total, 5 were completed and 6 were only partially excavated.* I believe these units were dug by hand with trowels. Leaves and grass may have been shovelled from the first few centimetres. Soil was removed in arbitrary 10 centimetre horizontal levels (cf. Newton and Pollock n.d.:9). Floor plans were drawn for each level, and profiles were recorded for those units which were completed.

To carry out an effective programme of impact mitigation at the site, a number of methodological adjustments were necessary during the second phase of excavations in 1979. Two kinds of excavation were employed. Standard hand trowelling was employed in areas such as the

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* These 6 units became the subject of investigations in 1980 fieldwork; at the close of Newton and Pollock's excavations in 1979, these latter units were lined with plastic and backfilled.

observation deck platform. Here, artifacts were uncovered by trowel in natural levels determined by soil horizons. Proveniences were piece-plotted for each lithic, bone and fire broken rock item. The second form of excavation involved shovelling and screening. Arbitrary five or ten centimetre levels were shovelled from one metre square units. This earth was screened by hand under a tripod. More commonly, it was power screened. No controlled surface collection was engaged in. Artifacts were occasionally recovered from the surface. A handful of artifacts were surface collected from the excavation for the foot path running along the terrace below the site. As well, the augured material from post holes was collected in sequence from each post hole, where possible. Finally, some material was surface collected while investigators monitored aspects of the construction projects once they were in progress.

Location of Units

The original co-ordinate system for the site employed minimum 2 metre units. Excavation units were given by the co-ordinates of the north-west corner, which also served as a datum. The first figure given for each unit is a westing, the second, a northing. Each of the units listed for Newton and Pollock's excavations are 2 x 2 metres in size. To accommodate proveniences within one metre squares used in the second episode of excavations in 1979, it was necessary to make use of half unit figures. This can be seen in examples presented below. Since July of 1980, a one metre grid system has been in place at the site. This professionally conducted survey tied the grid to permanent data and landmarks.

The 2 x 2 metre units initiated by Newton and Pollock are shown in Figure 2. Unit 81.0/26.0 is the farthest to the northwest of these. Units 57.0/15.0, 59.0/13.0, 65.0/12.0 and 65.0/13.0 are grouped together to the southwest of this, on the edge of the terrace. Units

22.0/12.0, 23.0/11.0 and 23.0/12.0 were excavated adjacent to 1978's 22.0/11.0 to form a 4 x 4 metre excavation block just west of the exit gate area. Finally, units 23.0/18.0, 23.0/19.0 and 23.0/20.0 were placed immediately to the north of the exit gate area.

Excavation was carried out in essentially four areas by Ives in the fall of 1979. For the sake of convenience, the four excavation areas will be referred to as the observation deck area, the interpretive centre area (the display/laboratory building), the picnic pavillion bicycle path excavations and the exit gate excavations (the southeast gate area). A plan of the Strathcona Science Park Archaeological Centre development is presented in Figure 2.

Observation Deck Area: A total of 8 square metres were completely excavated here. These were within a 2 x 4 metre area defined by the corner points 97.0/16.5 (SW), 95.0/16.5 (SE) and 95.0/17.5 (NE). All excavations in this unit were conducted by hand trowelling and piece-plotting.

Interpretive Centre Area: A total of 14 square metres of one metre trenching were excavated at this location. These were distributed as 10 metres of trench running west from 65.0/74.0 to 70.0/74.0, and 4 metres of trench running south from 65.0/74.5 to 65.0/72.5. The surface levels of this L-shaped unit were trowelled to mean depths of 20 centimetres below the surface. This trenching was located near the centre stakes placed for the building, although their actual location is closest to the north wall of the now finished laboratory.

Picnic Pavillion Bicycle Path Area: In this case excavation began with three 2 x 2 metre units, respectively termed A, B and C, and running in sequence from southeast to northwest. A concentration of bone in B resulted in its expansion. Unit A was defined by the points 81.5/93.5 (NW), 81.5/92.5 (SW), 80.5/93.5 (NE). Unit C was defined by 88.0/100.0 (NW), 88.0/99.0 (SW), 87.0/99.0 (SE) and 87.0/100.0 (NE). Unit B eventually involved 10 square metres given by units 86.5/95.5, 86.5/96.0, 86.5/96.5, 87.0/96.0, 87.0/96.5, 87.5/96.0 and 87.5/96.5. Generally

speaking, excavation was carried out by shovelling and hand screening; where concentrations of bone and artifacts were noted, hand trowelling and some plotting took place.

Exit Gate Area: Work began at this location with a 10 metre segment of one metre trenching which extended from 15.0/15.0 to 20.0/15.0. Surface collecting, followed by hand trowelling and then shovelling and screening took place on the trench. Ultimately, it served as a baseline for partially contiguous 8 x 8 and 4 x 4 metre excavation blocks. The former was defined by the corner points 20.0/14.0 (NW), 16.0/14.0 (SW), 16.0/18.0 (SE) and 20.0/18.0 (NE), while the latter was defined by 17.0/18.0 (NW), 15.0/18.0 (SW), 15.0/20.0 (SE) and 17.0/20.0 (NE). Excavation was carried out entirely by shovelling and screening, although large, undisturbed artifacts (manuports, split cobbles, anvils and so on) from the lowest levels were plotted.

Conduct of Excavation

Commentary on the 6 partially excavated units from Newton and Pollock's 1979 work is withheld pending the results of follow-up work on these units in 1980. The uncompleted units were 23.0/18.0, 23.0/19.0, 23.0/19.0, 23.0/20.0, 57.0/15.0, 65.0/12.0 and 81.0/26.0. With respect to the 5 other units, 22.0/12.0, 23.0/11.0, 23.0/12.0, 59.0/13.0 and 65.0/13.0, the first listed had 4 levels each removed. The last unit, 65.0/13.0, had 3 levels removed. In 22.0/12.0, excavators recovered a projectile point (FjPi-29:4289) in level 2, a concentration of bone in level 3 and lithic reduction debris in the lowest level. Both 23.0/11.0 and 23.0/12.0 appeared to centre on "major lithic and manufacturing reduction areas". Evidence for historic burning appeared in level 1 of 59.0/13.0, while perhaps the most significant feature of excavations in 65.0/13.0 was the discovery of a prehistoric ceramic necksherd in level 2.

Conducting mitigative excavations in the fall of 1979 was not a simple task. First, aspects of the development occurred on a scale

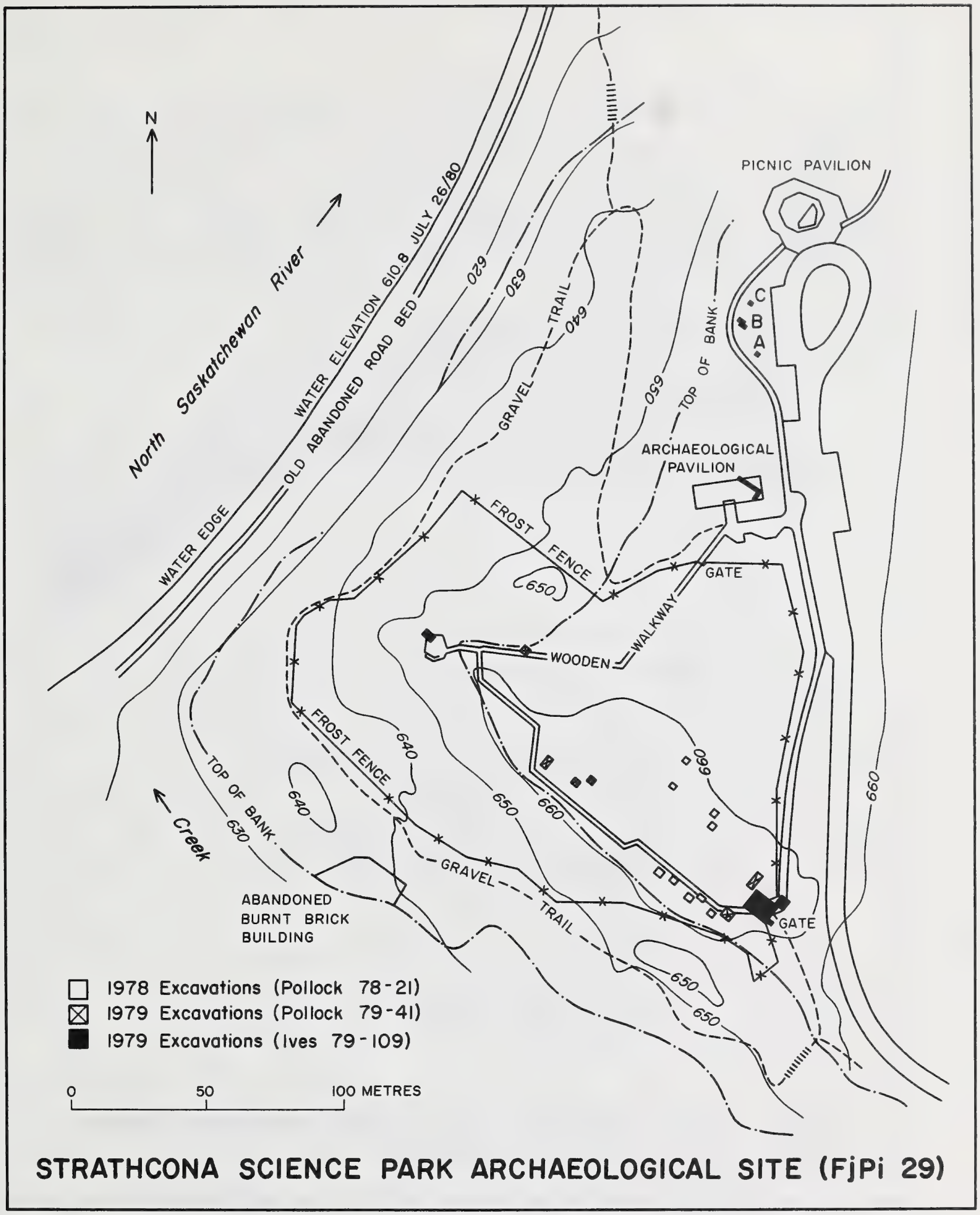
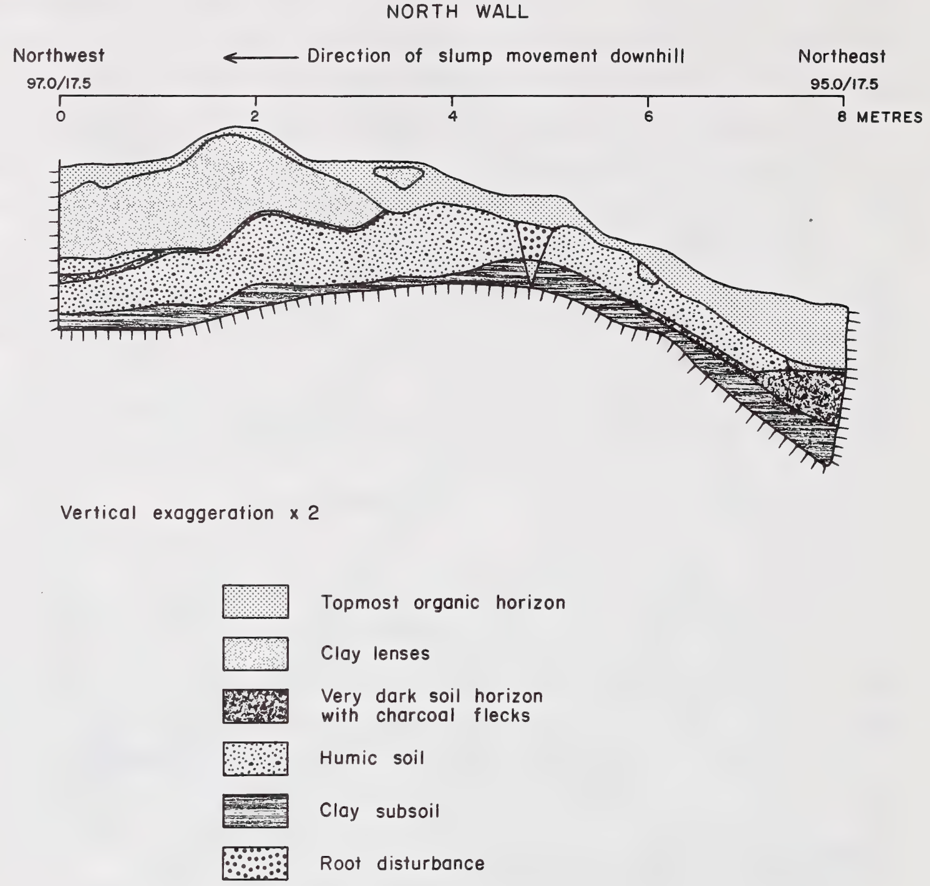


Figure 2: The location of 1978 and 1979 excavations at FjPi-29 shown in relationship to development now in place.



NORTH WALL PROFILE OF SLUMP BLOCK UNDER OBSERVATION DECK, FjPi 29

Figure 3. Soil profile in the observation deck area. Excavation units were located upon a slump block. Largely intact soil horizons bearing artifacts appear to have moved downslope as a unit.

that prevented total mitigation and necessitated only monitoring of areas suspected of being less sensitive archaeologically. Second, consulting landscape architects were slow and inaccurate in identifying potential sources of subsurface disturbance, precise locations of construction and the timing of construction phases. These problems were aggravated by the fact that earlier work had not delineated the true extent of the site. The interpretive centre building area, once believed to be off the site, did produce artifacts upon testing, as did the picnic pavillion bicycle path.

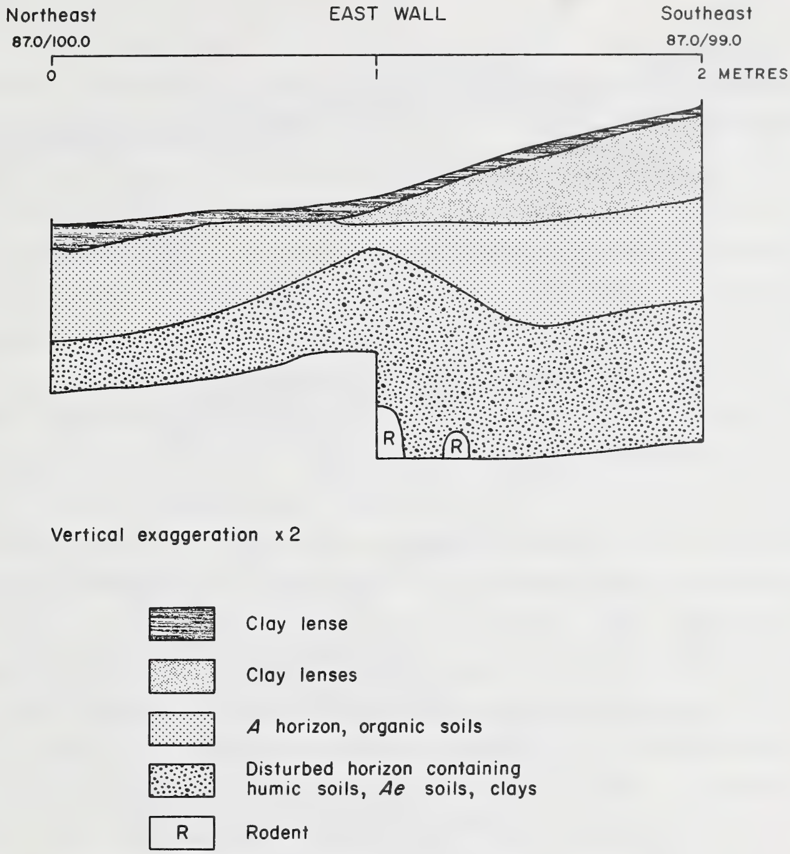
From the perspective of the Archaeological Survey of Alberta, our initial concern focussed on the observation deck area. Here, clearing would go on and pilings would be driven. Since the stratigraphy and surface configuration of this slump block suggested that true horizontal and vertical relationships between the artifacts present might have been maintained, excavation proceeded cautiously. This area was successfully mitigated by the 2 x 4 metre unit which covered virtually all of the available flat area of the slump block. From the configuration of disturbed soils in this area, it seems as though the entire block proceeded down-slope to a more stable position. There is less soil material toward the back of the slump block (Figure 3).

This task was followed by work in both the building and exit gate areas. Fourteen metres of trenching were placed in the former area. Note that this excavation was not completed to sterile B or C horizon clays. While artifacts were located in this trench, they were at a lower density and were in a disturbed context. As the development proceeded, it was decided that this was sufficient mitigation given the resources available. Further mitigation was in the form of monitoring construction. A handful of artifacts were recovered as earth moving equipment prepared the foundation for the building. Initial work in the exit gate area revolved about the 10 metre trench. A gate location was specified and a 5 x 6 metre unit was surveyed

and excavated. Subsequently, to ensure total coverage in this highly productive area, the 5 x 6 was expanded to an 8 x 8 metre unit (Figure 28). To this was added the 4 x 4 metre unit. This excavation recovered the vast majority of artifacts collected under Permit 79-109, with artifacts occurring in both disturbed and undisturbed strata. This was a successful mitigation of virtually the whole impact area. The chief form of damage would result from laying a concrete pad.

While excavation in the exit gate area went on, the field crew also worked on the test 2 x 2 metre units placed on the bicycle path. Generally speaking, artifact densities were spotty and low in this area as well. Unit B did produce a considerable amount of bone which seemed to represent the remains of butchering activities (Figure 29). The expansion to 10 square metres removed all or the majority of bone from this area. Profiles also indicated a fair degree of generalized disturbance along the path (Figure 4). Once the 18 square metres had been excavated, development was allowed to proceed with monitoring. A handful of artifacts were again recovered.

By and large, mitigation of the site for the interpretive development was successful. The pace and scale of construction did make for less effective treatment of the interpretive centre and bicycle path areas. However, these were not the most sensitive site areas, and the size of the proposed developments would have prohibited complete mitigation by excavation in any consideration of these areas.



EAST WALL PROFILE, UNIT C, PICNIC PAVILION BICYCLE PATH, FjPi 29

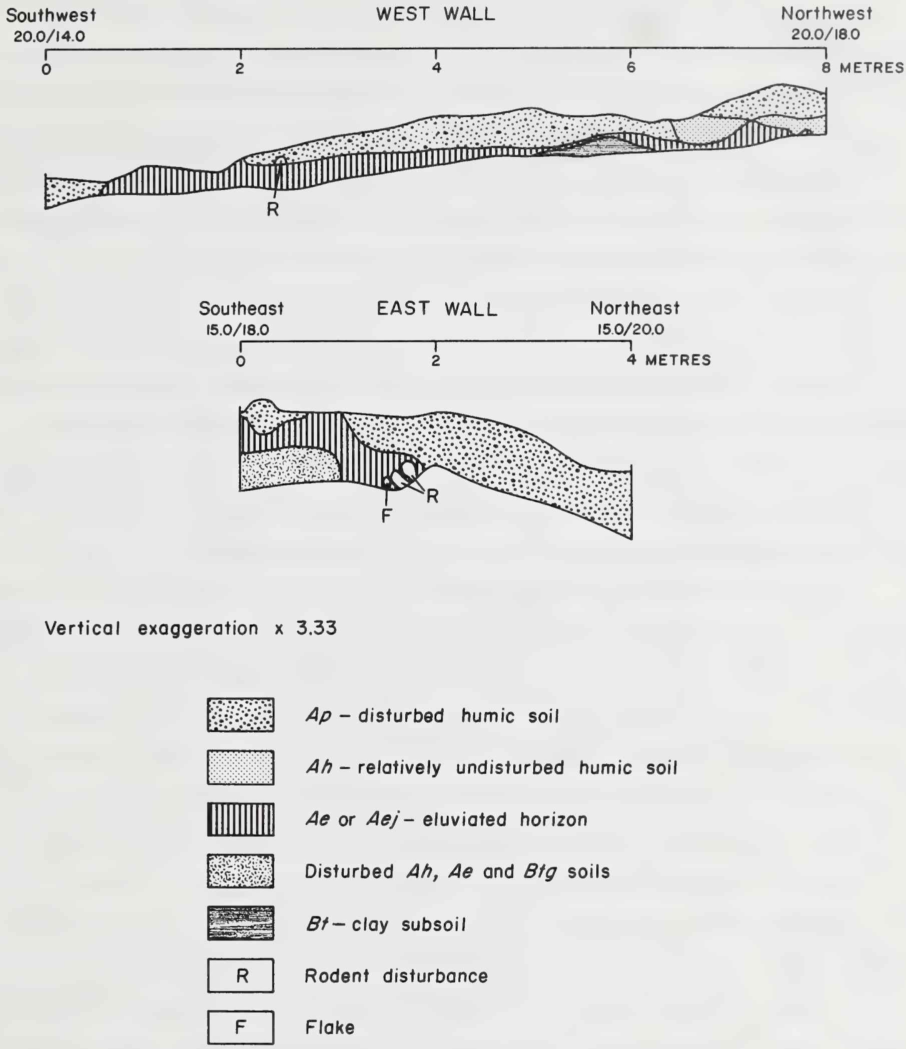
Figure 4: Soil profile from unit C showing stratigraphic disturbance in Picnic Pavilion Path area.

III: STRATIGRAPHIC DEVELOPMENT AND SOIL CLASSIFICATION

As Newton and Pollock (n.d.) point out, the prehistory of the Strathcona Science Park Archaeological Site is intimately tied to the development of the North Saskatchewan River Valley. Following the last glaciation, the North Saskatchewan River began to cut its valley soon after the drainage of glacial Lake Edmonton. Through a history of periods of degradation and aggradation likely controlled by flucuations in the position of the Keewatin ice front to the northeast, the river formed four postglacial alluvial terraces in the Edmonton area. An analysis of air photos and topographic maps suggests that FjPi-29 is situated on the "middle" or 100 foot terrace of the North Saskatchewan River (P. Waters, personal communication; Westgate 1969; cf. Newton and Pollock n.d.:11). Very little is known about the intermediate terraces in the city area. Conservative estimates would place the formation of this terrace some time between 12 to 13,000 years ago and 6600 years ago (cf. Westgate 1969; P. Waters, personal communication). The latter date is based on the presence of Mazama ash in the lower terraces. The site has probably been habitable for the last 10,000 years or more.

As the North Saskatchewan valley was incised, a series of sediments were exposed. These included the Saskatchewan Gravels, the apparent source of raw material for the lithic workshop at the site. Silicified wood which occurs at the site probably derives from Mesozoic or Tertiary aged sediments similarly exposed.

A variety of soils occur on different drainage catenas at the site. Orthic Black Chernozems are the principal form (Agriculture Canada 1976: 54). Archaeological excavation and construction activity in the observation deck, the interpretive centre and picnic pavillion bicycle path areas encountered primarily Orthic Black Chernozems. There are some poorly drained areas along the north edge of the site, and Gleysols are present in those locations. The exit gate area also has somewhat different drainage and soil characteristics. A sequence of Ap, Ae and



PROFILE OF THE WEST WALL (8 x 8 metre unit) AND THE EAST WALL (4 x 4 metre unit), EXIT GATE, FjPi 29

Figure 5. Sequence of soil horizons typical of the exit gate area. Topmost A horizon soils at this location have been significantly disturbed. Underlying horizons have not. An impression of the increasing depth of deposits from south to north is given by joining the southeast corner (15.0/18.0) of the east wall of the 4 x 4 with the northwest corner (20.0/18.0) of the west wall of the 8 x 8.

Btg horizons was revealed by excavation in this area (Figure 5). Hydrometric analysis showed a 15% clay content in the Ap horizon, disturbed most recently by construction associated with park development. The Ae had 24% clay content, while the Btg horizon was enriched with 56% clays from the overlying horizons (P. Waters, personal communication). This soil is regarded as a Luvic Gleysol (S. Pawluk, personal communication; Agriculture Canada 1976:68-70).

Newton and Pollock (n.d.:11) make reference to a volcanic ash in unit 22-11 located at the southeast end of the site in the exit gate area. Contrary to that report, the phenomenon in question does not appear to be a volcanic ash. Rather, it seems to be the Ae horizon referred to above. No volcanic glass shards were detected in the hydrometric samples discussed above. These samples do fulfill the requirement for classification as an Ae horizon.

There are several archaeological implications to this information. There is little in the way of stratigraphic development in the deposits which contain prehistoric artifacts (the upper 40 centimetres of the column). No excavators have reported concrete evidence of natural stratigraphy at these depths. In all likelihood, it will not be possible to demonstrate natural stratigraphic separation of artifacts from different time periods. At the same time, profiles from various areas of the site document widespread historic disturbance. Gibson (n.d.: 25), speaking on the basis of the 1979 magnetometer survey results, reached the conclusion that significant historic disturbance had taken place because numerous pieces of metal were located at various depths over large areas of the site. The presence of eluviated soil horizons on portions of the site thus becomes an important means of determining depth and degree of disturbance. In the exit gate area, the light colours of the Ae horizon show clear signs of mottling when mixed with disturbed matrix during excavation. Artifacts occurring in and below the Ae horizon had not been artificially disturbed, while overlying soils and artifacts had been moved to an undetermined degree.

A corollary of the presence of different soils on the site is that a mosaic of preservational environments exist for bone. By and large, bone preservation at FjPi-29 is fair.

It is worth noting that the most recent investigations at the site do not favour interpretations which suggest that cultural stratigraphy is well developed at the site. Since the author's work often involved disturbed locations such as slump blocks and the southeast gate area, this is more accurately a subjective impression. Nevertheless, detailed three dimensional plots and depth tabulations of artifacts found during the 1980 excavations do not reveal significant differences in artifact depths. Excavation units occurred in several areas of the site, several being noteworthy for lack of evidence of obvious disturbance (H. Pysczyk, personal communication). A pervasive problem in both interpretation and research at this site will be the lack of stratigraphic control.

IV: SPATIAL ANALYSIS OF THE 8 x 8 METRE UNIT AT THE EXIT GATE

Methodology

Because the exit gate area was to be seriously disturbed by paving and the laying of a concrete pad, it was an obvious source of concern during the fall of 1979. This was especially so since the area had a high surface density of artifacts and there was every reason to believe this trend would continue with excavation. These more desirable encouragements to excavate were certainly tempered by clear signs of disturbance which had occurred sometime during the early phases of construction in the park complex. With these factors in mind, I made the decision to excavate a large area in a format suitable for spatial analysis.

There is little question that distance methods are superior to grid counts in spatial analysis (cf. Hodder and Orton 1976:38; Ives 1977). As a consequence, there is an inevitable loss of data when grid counts of artifacts are the only form of provenience. In this case, the 8 x 8 metre unit in the exit gate area, the time involved in piece-plotting roughly 9,000 items would have been prohibitive to carrying out impact mitigation. Then again, far in excess of half of the artifacts were not in their original provenience anyway. A grid count was therefore preferred. The 8 x 8 metre grid size was selected because this particular set of dimensions is suited to what has been variously referred to as "dimensional analysis of variance", "mean square block analysis" or the "analysis of a contiguous grid of quadrants and the detection of pattern".

Greig-Smith (1964:54-93) and Kershaw (1973:128-144) summarize the application of quadrat statistics which use grid counts. A mean number of individuals per grid unit is calculated from known density. Variance (from the mean) in quadrats is then calculated. Under the Poisson distribution, the variance equals the mean. In a random population, the

variance/mean ratio is expected to equal unity. Significance of departure of the observed variance/mean ratio from the expected variance/mean ratio can be assessed by a _t_-test or by chi-square goodness of fit. It has been demonstrated, however, that both the size (Skellam 1952) and the shape (Clapham 1932) of the quadrat can influence density count and hence, variance/mean ratios. It is necessary to make use of different quadrat sizes to accurately detect non-randomness in a distribution, obviously a time consuming endeavour. Different random samples for a series of block sizes would have to be drawn.

Mean square block analysis a logical outgrowth of this problem of quadrat size (see Thompson 1958; Greig-Smith 1964:88-93; Kershaw 1973: 138-144; Whallon 1973). In this case, a contiguous grid of T quadrats is laid out. Each side of this grid must be some power of 2 in length. The number of points in each quadrat (the ultimate grid unit or 1 metre square in this case) is then counted. Analysis proceeds by the successive doubling of original quadrats into oblong followed by square blocks. Sums of squares for each block size of j quadrats are calculated according to the formula (Thompson 1958:326):

$$Sj = \frac{1}{j} \sum_{i=1}^{T/j} (B_{j(i)})^2$$

where $B_{j(i)}$ is the number of points in the ith block of j quadrats, and the values of B^2 are summed over all such blocks. T is the total number of quadrats in the grid. The "mean square between blocks" (M_j) can then be calculated:

$$M_j = \frac{(S_j - S_{2j})}{F_j}$$

where F_j is the degrees of freedom and is defined as:

$$F_j = \frac{T}{2_j}$$

A mean square/mean ratio is obtained by dividing the mean square by the mean number of items per block at that block size. Mean square or mean square/mean ratios can be displayed graphically. As block size approaches the size of any actual concentrations, there is a greater tendency for concentrations to fall entirely within blocks, thus increasing the value of M_j. Therefore, graph peaks represent the block size at which spatial concentration occurs. It can be seen that this method allows a conceptualization of the scale or grain of a pattern.

Although a number difficulties have been listed for this ingenious application of an ANOVA type of test, assessing the significance of graph peaks is the most difficult of these (cf. Pielou 1969:105). Testing the significance of mean squares at larger block sizes against smaller block sizes (say, block size 1) by a variance ratio (F) test cannot be justified statistically. The F test requires the assumption that quadrat frequencies are normally and independently distributed, an assumption that is violated if items are aggregated in space (Thompson 1958:326). In plant ecology, Greig-Smith (1961:698) suggests relying upon consistency of peaks in a series of observations as evidence of ecological significance. As an alternative, peaks can be assessed for statistical significance by plotting upper and lower significance bands for the mean square/mean ratio graph (Thompson 1958:327, Greig-Smith 1961:698-699). High mean square/mean ratios peaking above the upper significance band indicate aggregation while low mean square/mean ratios falling below the lower significance band indicate uniformity. However, variance/mean ratio types of test such as this behave erratically at different densities of items (Greig-Smith 1964:60). As my chief intent in this application is merely to distinguish more objectively between potential contributors to spatial patterning, peaks in the mean square values only are used as a guide in interpretation.

Results and Interpretation

From the foregoing discussion, I hardly need point out how difficult

it is to assess the distribution of artifacts on this portion of the site. There are three major sources contributing to any spatial patterning which might be observed at this location. First, there is spatial patterning that could be attributed to the non-random, aggregated clusters of artifacts one invariably expects to find resulting from the expedient discard of waste products during manufacture. Second, this pattern is compounded in its complexity to the degree that similar clusters of artifacts might be superimposed through time. Finally, there has clearly been extensive surficial disturbance on the southeastern portion of the site. Some type of earth-moving equipment has bladed much of the upper soil horizons in this area.

As subsurface horizon depths were correlated with microtopographic features in this area, initial hopes faded that meaningful spatial relationships between artifacts might be preserved. Instead, it became apparent that rigourous controls would be necessary simply to interpret the combination of sources which might have led to the spatial configuration present.

While all surface portions of the 4 x 4 and 8 x 8 metre units seem to have been seriously disturbed, lower lying levels have not been equally affected. Figures 6, 7 and 8 show the distribution of units which were felt to have partially disturbed soil matrix (in which artifacts quite likely would not have moved so far), undisturbed soil matrix units and both conditions plotted together. For the purpose of this analysis, Figure 8 shows a nearly continuous subsurface level suffering little or no effects of disturbance. Figures 8, 10 and 11 provide density plots of all artifacts (including debitage) as they are distributed through these levels categorizing disturbance. Similarly, Figures 12, 13 and 14 show the distribution of finished and partially finished tools and fabricators through soil disturbance levels. Note the tendency of this latter group of distributions to parallel that for all artifacts.

The mean square values plotted in Figures 15 and 16 do provide preliminary indications about the scale at which patterning in artifact distributions occurs on this portion of the site. Figure 15 shows three sets of mean square values: that for all artifacts in all levels; that for all artifacts in completely disturbed contexts; and that for all partially disturbed and undisturbed artifacts. Figure 16 shows plots for the same recovery contexts, in this case the values graphed being for finished and unfinished tools as well as fabricators (such as hammerstones and anvils). I will confine my remarks to Figure 15 since very much the same trends are duplicated by the graph for finished and unfinished tools as well as fabricators.

Taking note of the constraints inherent in dealing with a single analysis, effectively three scales of patterning occur for all artifacts in all levels. That graph suggests non-random spatial clustering at block sizes 4, 16 and 32. In turn, this indicates the presence of spatial aggregates in the 2 x 2 metre, 4 x 4 metre and 4 x 8 metre size ranges. Nevertheless, this combined plot is most likely to represent composite sources of patterning. In fact, as we juxtapose the graphs for disturbed as opposed to partially or undisturbed artifacts, some significantly different trends emerge. The plot for disturbed artifacts is quite similar to that for all artifacts in all levels. There is apparently a tendency toward clustering at block sizes 4 and 16 (2 x 2 metre and 4 x 4 metre size ranges). Note, however, that the mean square value for block size 32 drops off significantly. Values for the graph of partially and undisturbed artifacts are markedly lower than that for the larger sample sizes of the other two categories. Again there is peaking at three block sizes. These are block sizes 1, 8 and 32, or in the 1 x 1 metre, 2 x 4 metre and 4 x 8 metre size ranges.

I would suggest that the combined graph of all artifacts in all levels obscures the different trends present. Let us first consider large scale patterning since it most likely has to do with disturbance. Upon inspection of raw totals, the chief discrepancy in the distribution

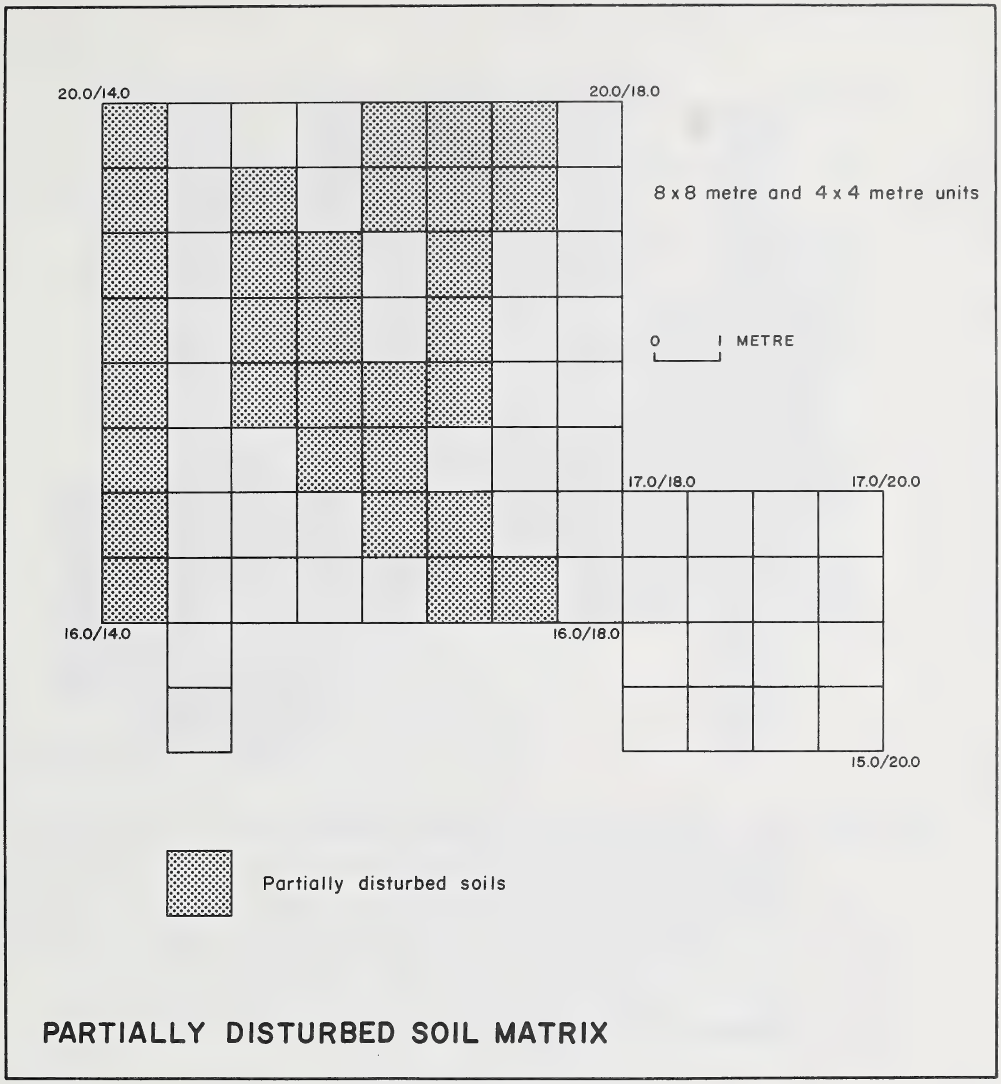


Figure 6: Units with levels marked by partial disturbance in which the spatial disruption of artifacts is believed to be minimal.

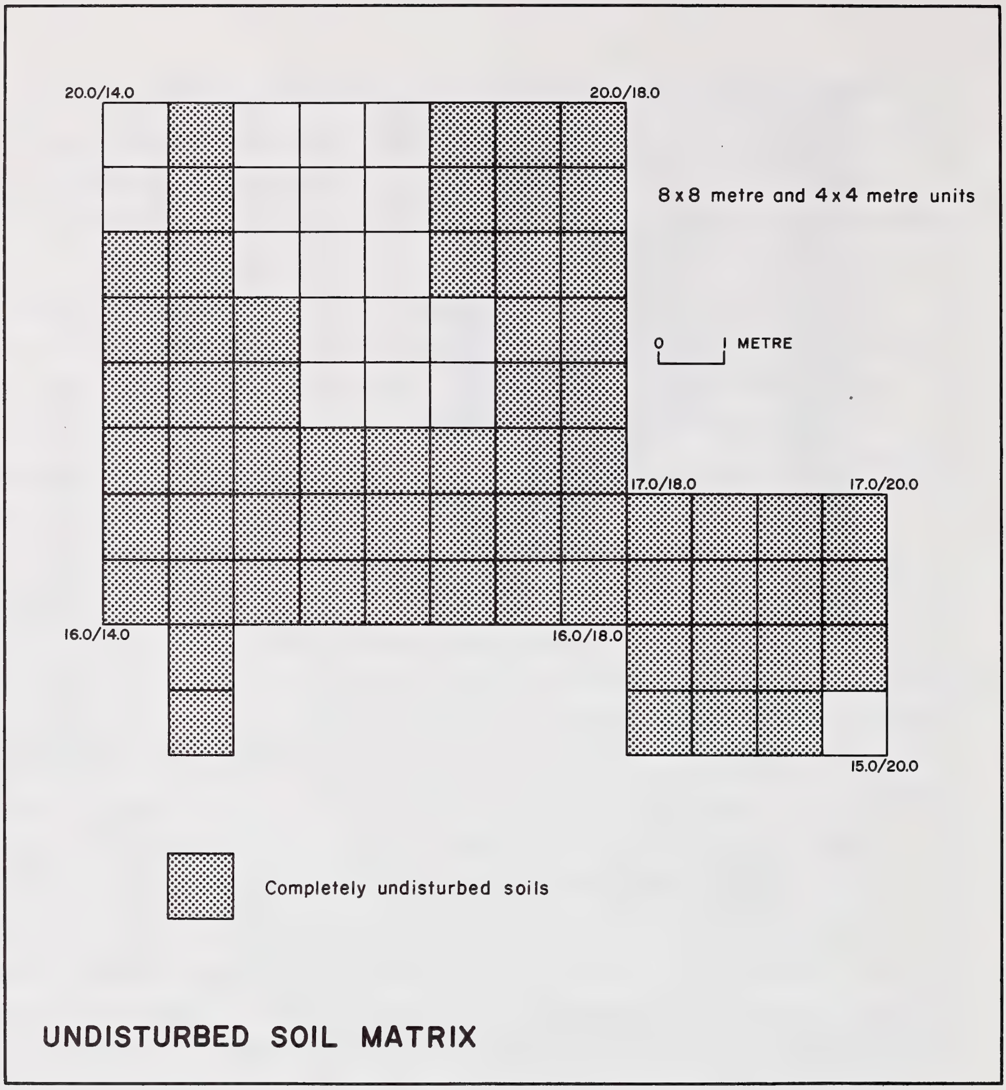


Figure 7: Undisturbed soil horizons where artifacts were not disturbed artificially.

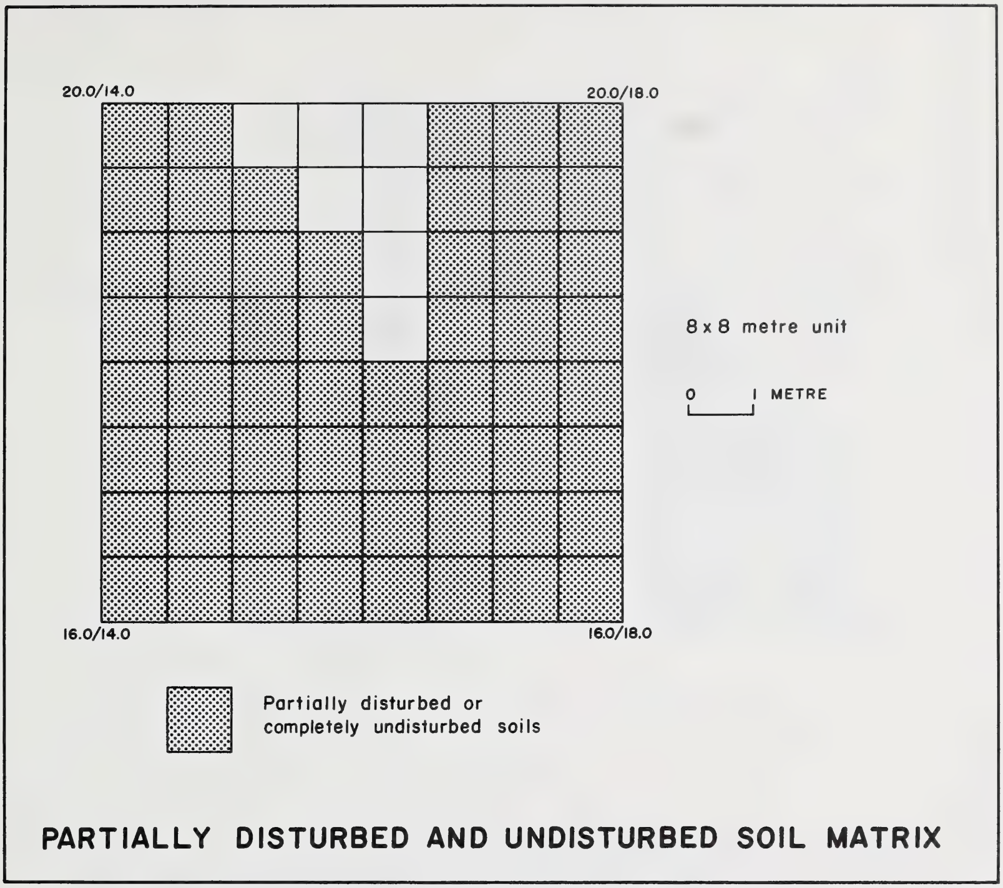


Figure 8: Patially disturbed and undisturbed units which almost completely cover the 8 x 8 metre excavation unit in the exit gate area. Artifacts from these levels have been minimally disturbed or are totally undisturbed by artificial factors such as construction.

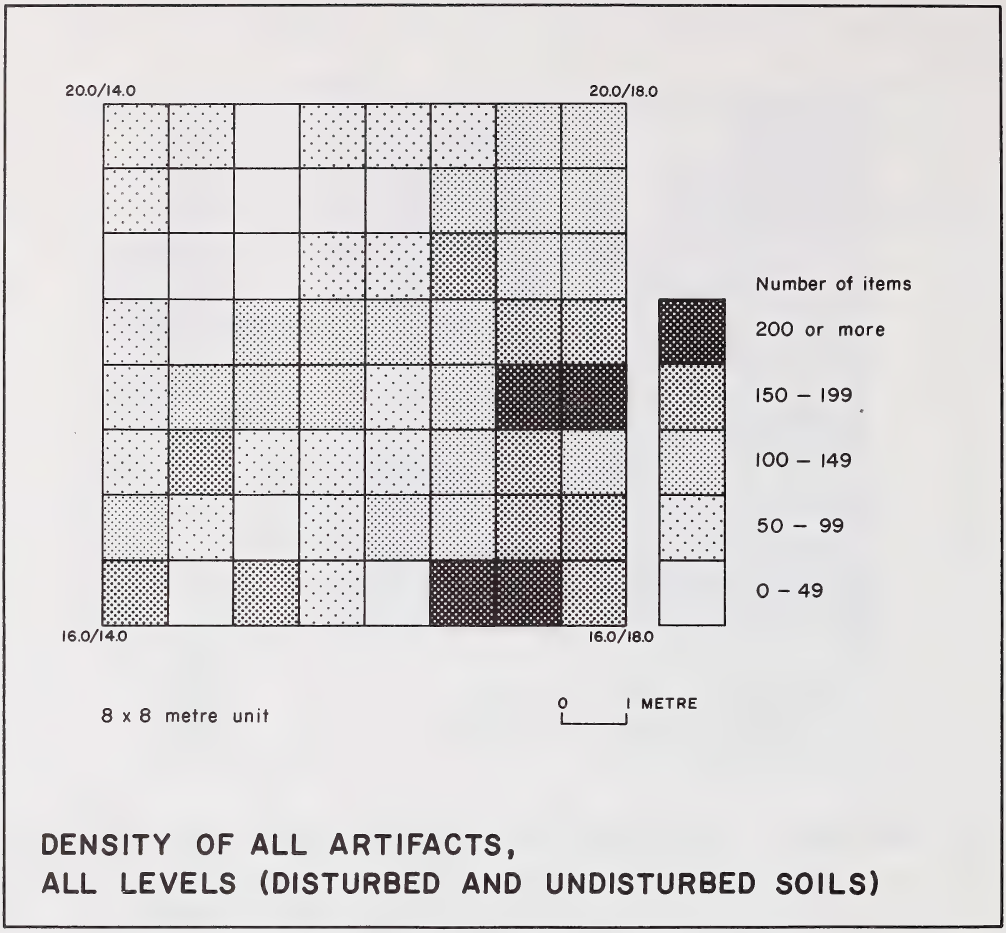


Figure 9: Density plots for debitage, fabricators, finished and unfinished artifacts recovered from all levels in the exit gate 8 x 8 metre unit.

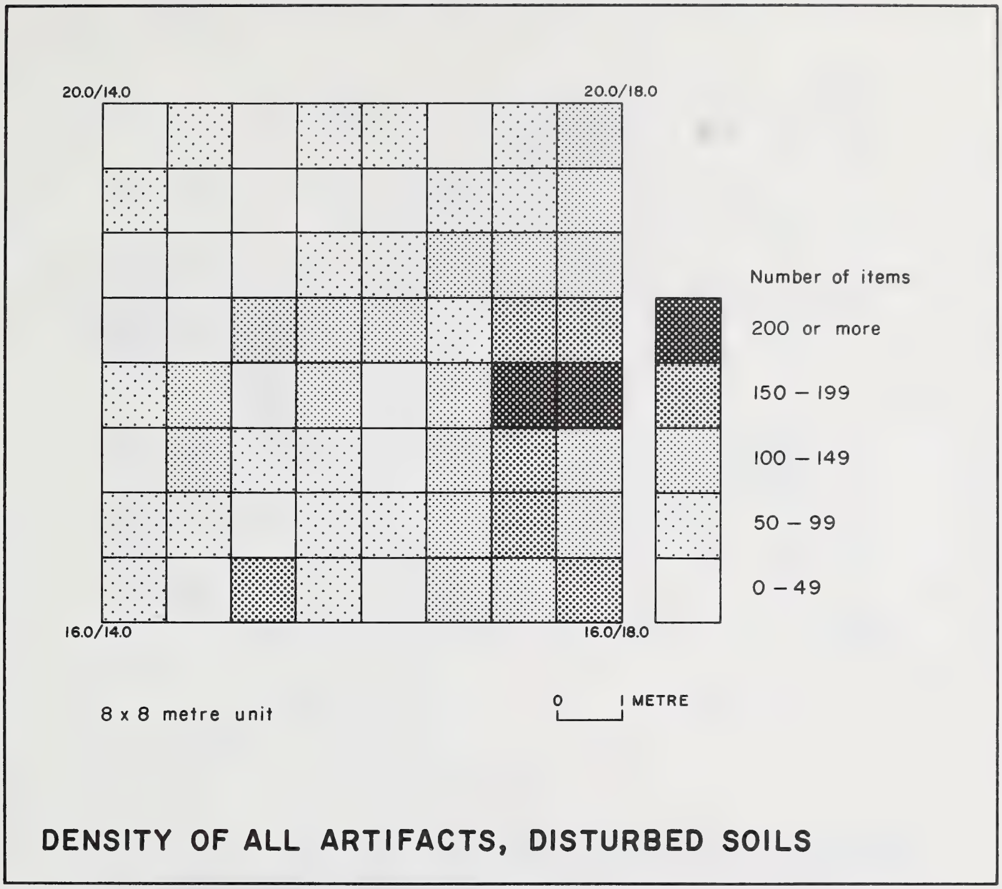


Figure 10: Density plots for all artifacts coming from more thoroughly disturbed upper levels in the exit gate 8 x 8 metre excavation unit.

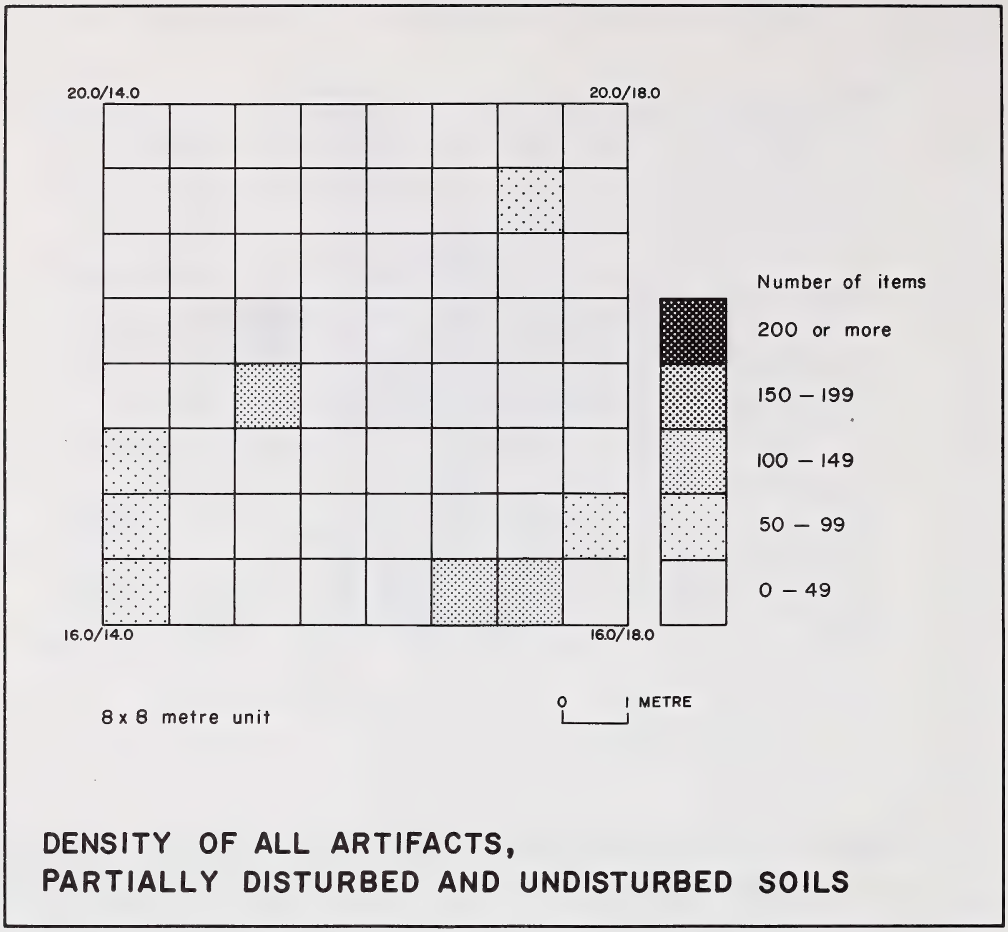


Figure 11: Density plots for all classes of artifacts discovered in partially disturbed or completely disturbed soils.

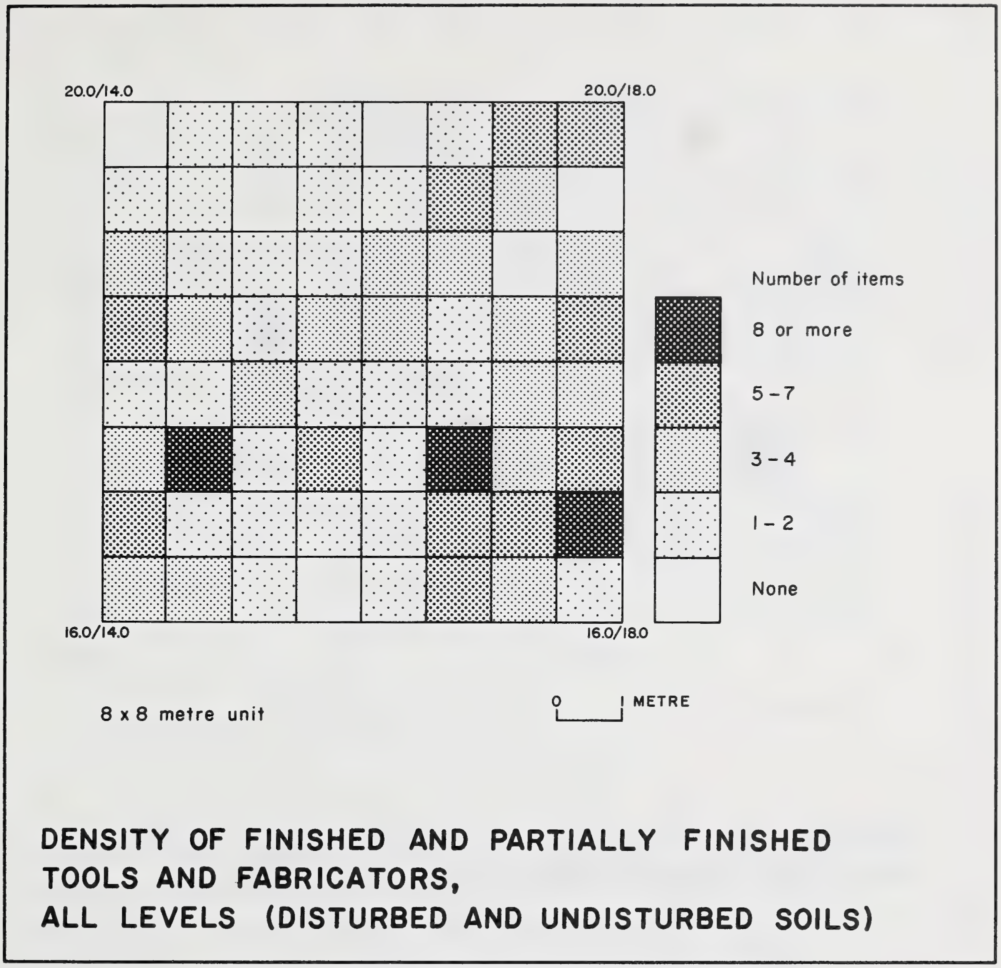


Figure 12: Density plots of finished and partially finished tools, as well as fabricators, which were recovered from all excavation levels.

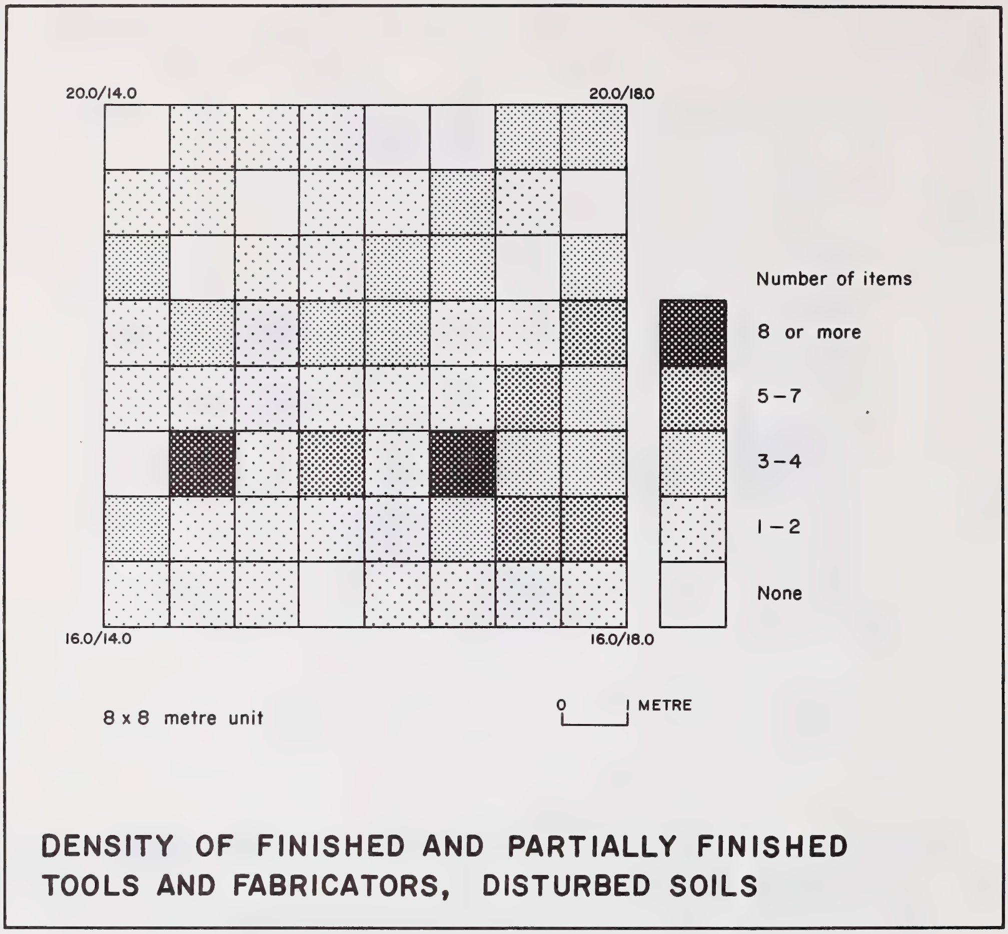


Figure 13: Density plots of finished and partially finished tools and fabricators recovered from disturbed contexts.

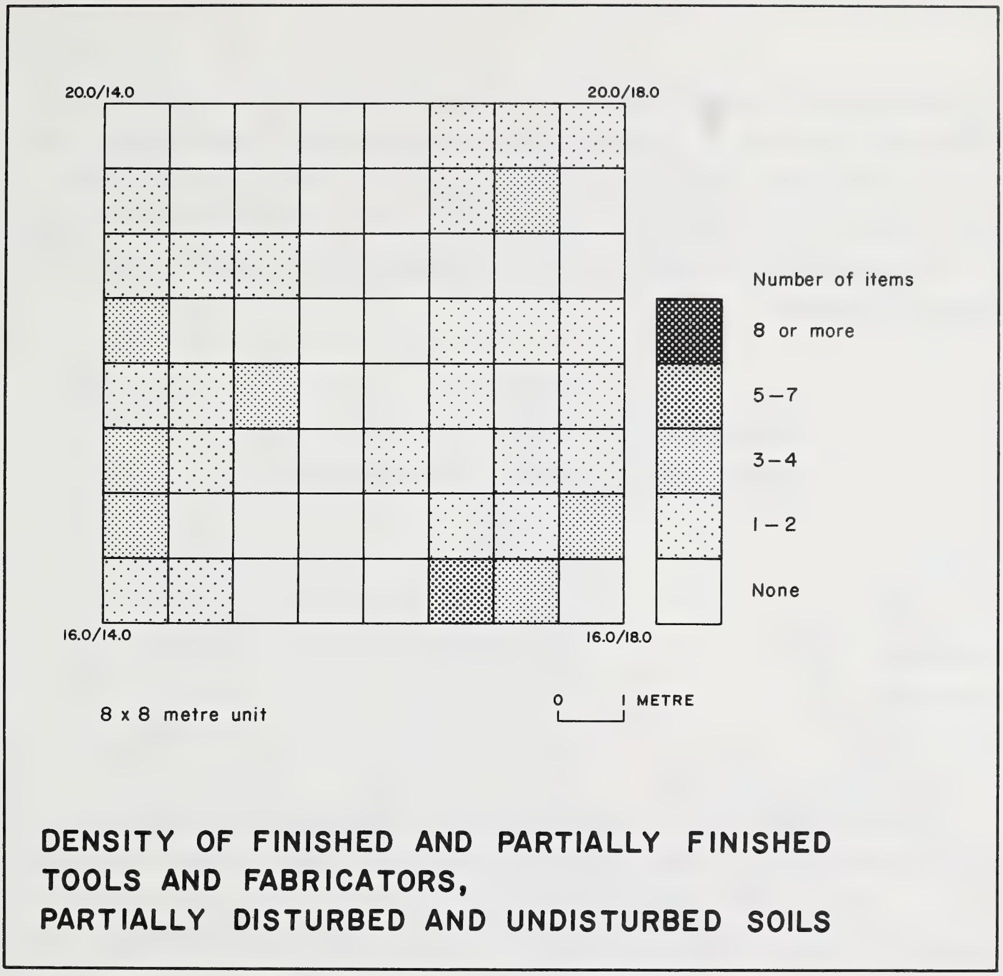


Figure 14: Density plots of finished and partially finished tools and fabricators discovered in undisturbed or partially disturbed soils.

of artifacts in the four quadrants of the 8 x 8 appears to be between northeast and southwest quadrants where nearly three times as many artifacts occur in the former as in the latter. Once the artifacts are partitioned into 4 x 8 metre blocks, the ratio of artifacts in the east half to the west half pretty much approaches the north half to the south half ratio.

TABLE 1
ARTIFACT RATIOS BETWEEN 4 x 8 METRE BLOCKS
WITHIN THE 8 x 8 METRE EXCAVATION UNIT

Context	North:South	East:West
All Levels	1.67:1.00	1.53:1.00
Disturbed	1.87:1.00	1.40:1.00
Partially and Undisturbed	1.13:1.00	2.14:1.00

Much the same set of relationships is manifest in a quadrant by quadrant breakdown of disturbed artifacts only. The northeast quadrant greatly predominates over the southwest, again by nearly three times. A more distinct difference is noted once the quadrants are grouped into 4 x 8 metre blocks. As can be seen in Table 1, there are nearly twice as many artifacts in the north half as in the south half; the difference between east and west halves is not nearly as distinct.

To conclude, the northeast quadrant is nearly two times as artifact rich as the southwest quadrant among the partially disturbed and undisturbed artifacts. This breakdown is different in that the southeast corner is also twice as productive as the southwest and northwest quadrants. When quadrants are combined for Table 1, twice as many artifacts occur in the east half as in the west half. The discrepancy between north and south halves is not so great.

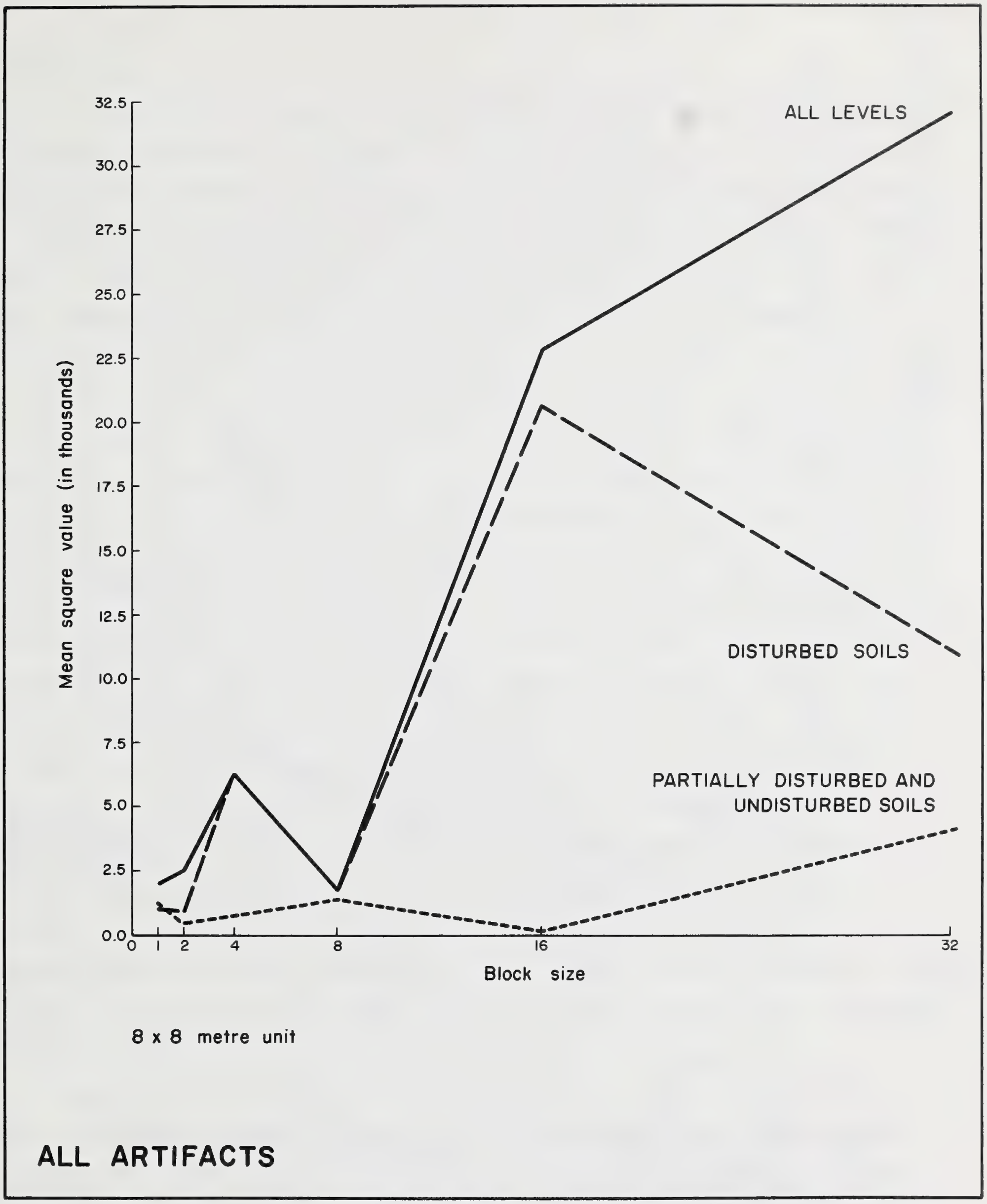


Figure 15: Results of a mean square block analysis of all classes of artifacts recovered from the 8 X 8 metre excavation unit at the exit gate. The solid line represents all artifacts from all levels of the site and shows a tendency toward peaking at block sizes 4, 16 and 32. The heavily dashed line shows artifacts from disturbed context only; peaking at block sizes 4 and 16 is indicated. The lightly dashed lines show slight peaking amongst all artifacts from partially disturbed or undisturbed soils. This occurs at block sizes 1, 8 and 32.

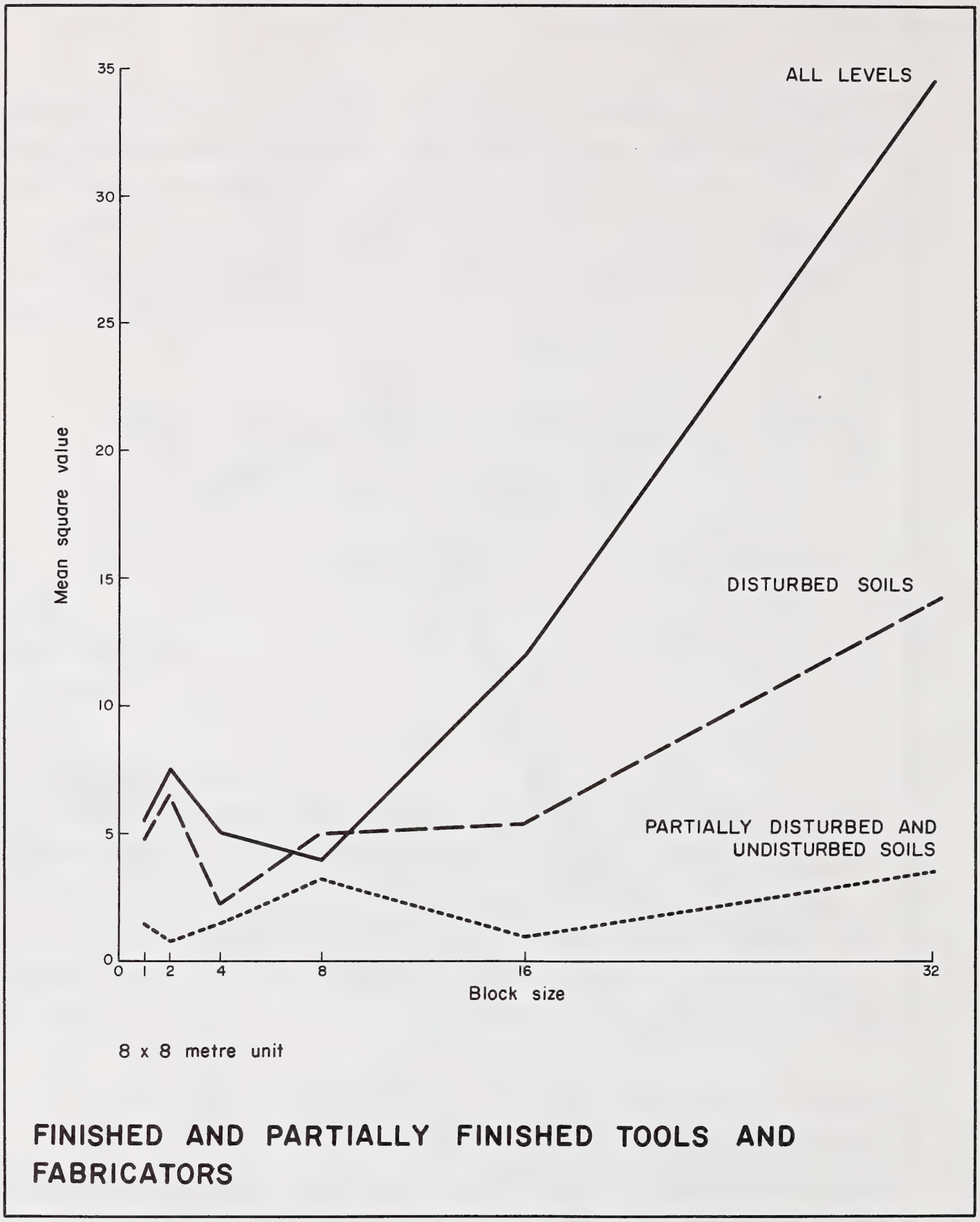


Figure 16: Results of a mean block analysis of finished and partially finished tools and fabricators from different levels in the 8 X 8 metre excavation unit at the exit gate. Note the degree to which peaks in mean square value parallel those for all artifacts in figure 15. This result can be taken as one form of evidence for a close correspondence between discard locations for finished tools and fabricators and loci at which concentrations of manufacturing debitage occur.

I am prepared to suggest that the patterning of disturbed artifacts documents a southwest to northeast trending (perhaps more accurately south to north trending) of disturbance in which artifacts were bladed or dragged to the northeast (or north). The increasing depth of profiles moving in this direction tends to bear out this conclusion (Figure 5). Since these constitute the majority of artifacts, it is largely this pattern which is reflected in the results for all levels of artifacts. The largest peak in the latter category (4 x 8 metre size range or block size 32) appears, however, to be created by the peak in the partially disturbed and undisturbed levels. This raises the possibility of an underlying source of patterning not influenced by disturbance. Is there some prehistoric reality to this apparently east/west split?

There are two alternatives here. Were we to assume that artifacts were comparatively evenly distributed both horizontally and vertically within the 8 x 8 metre unit, then the proposed disturbance would have created the same effect as above simply by "robbing" some of the productivity of the southwest portion of the unit. On the other hand, there could simply have been fewer artifacts in this portion of the unit before disturbance ever occurred. Figure 17 lends some credence to this line of reasoning; the large artifacts mapped there were discovered in undisturbed contexts. It is difficult to be certain of this latter conclusion because there is little way to tell if larger artifacts resting in undisturbed contexts in the southwest quadrant were "plucked" out of that matrix and transferred across the unit.

It may be possible to go one step further. The large artifacts which were mapped were also selected for because of their size. There is definitely more of a "north/south" distribution here. In spite of this, the figures for all classes of artifacts in the partially and undisturbed level show that over twice as many artifacts occur in the east as opposed to west half. The total north/south ratio approaches unity, and there is no doubt that this east/west discrepancy creates the peaking in the mean square graph for block size 32. It could be

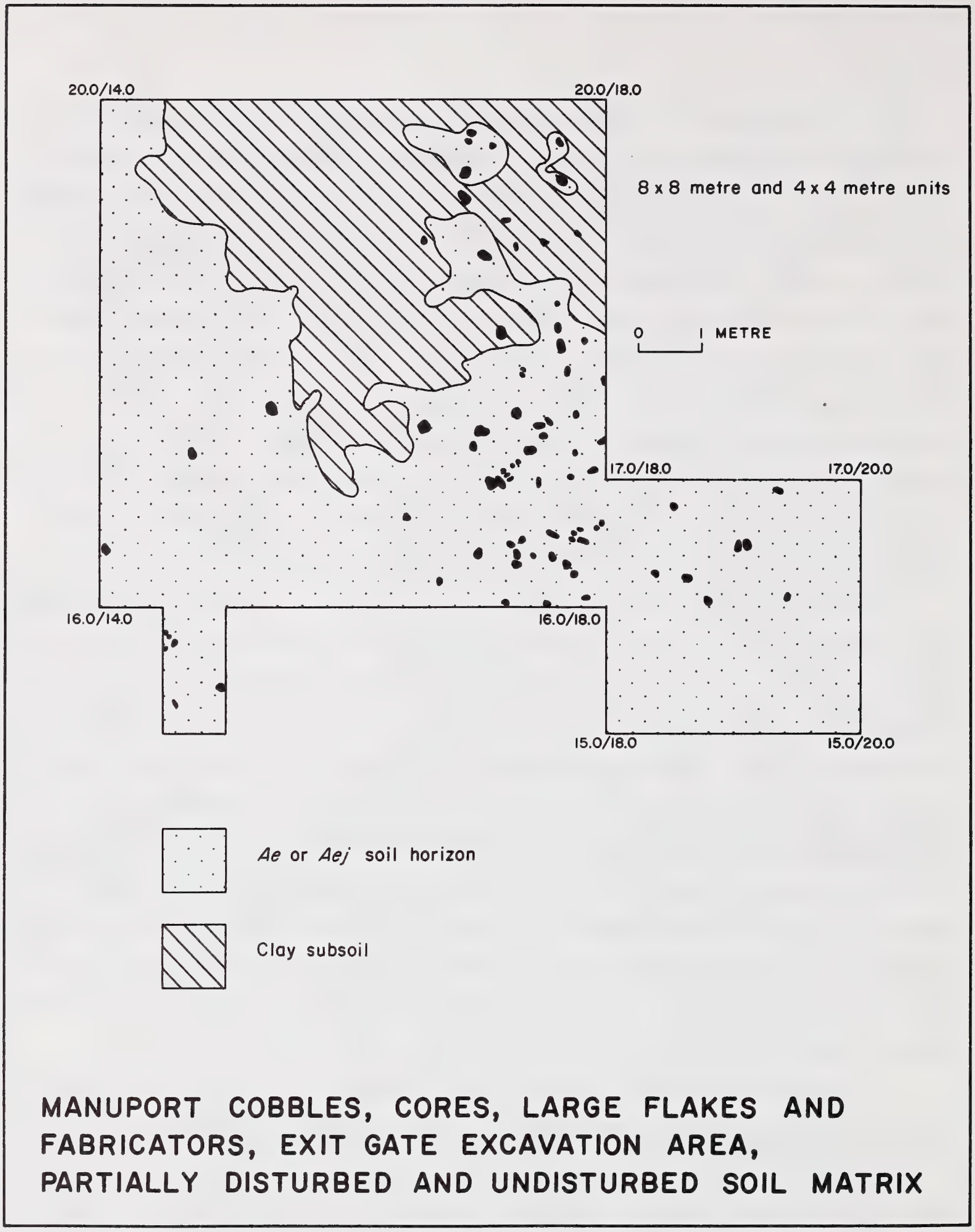


Figure 17: A distribution map of large specimens from undisturbed contexts in the 8 x 8 metre and 4 x 4 metre excavation units at the exit gate. Note the concentration of specimens toward the right hand side of the unit.

that the south or southwest to north or northeast trending caused by disturbed soils overlies an undisturbed, prehistoric east/west dichotomy in artifact distribution.

To close this section, I will address the smaller scales of patterning mentioned earlier. I suspect that the tendency for spatial clustering at the scale of 1 x 1 metre has particular reference to the rather small concentrations of debitage which occur in tool manufacturing and tool maintenance contexts (cf. Ives 1977). Naturally, the former situation is apt to prevail at a workshop site. The partially disturbed and undisturbed results also indicate clustering at scales on the order of 2 x 4 metres. If this is an accurate reflection, I would not be surprised if such a scale could represent small groups of two or three craftsmen or one craftsman shifting about a locus. Given the interpretive difficulties raised above, this is recognized as a highly speculative conclusion.

V. DESCRIPTION OF ARTIFACTS RECOVERED

Introduction

In 1979, 9,898 catalogue numbers were assigned to the artifacts collected during that field season. These represent a total of 15,687 items comprised of 13,545 modified lithic artifacts, 1,557 fragments of bone, 532 pieces of fire broken rock, 9 pieces of yellow ochre, 10 whole cobbles, 12 whole pebbles and 22 historic or contemporary artifacts. The disparity between catalogue numbers and total numbers stems from counting the contents of chip vials containing flakes and shatter too small to catalogue individually. Archaeological Survey of Alberta operations at FjPi-29 have brought to light 13,350 catalogued artifacts (bearing in mind the distinction made above). Pyszczyk (n.d.) reports that some 5,000 artifacts were recovered during the 1980 field season, so that the collection from the site is probably now on the order of 25,000 cultural items.

With respect to the 13,541 lithic items from 1979, 9,430 of which were recovered by Ives under Permit Number 79-41, several trends remained apparent. The ratio of debitage to finished and unfinished tools as well as fabricators was 31.5:1. Once artifacts directly related to the production process - cores, bipolar split pebbles, hammerstones and anvils - are removed from consideration, the ratio of debitage to non-fabricators becomes 59.7:1, a figure which serves to reinforce our notion of the site as a workshop. Parenthetically, I should add that this ratio is not so high as I had expected it to be. Tool rejects may inflate the number of artifacts placed in the non-debitage category.

There is effectively no change in our impression of the raw materials selected for use. Quartzite derived from cobbles by far predominates, constituting 79.8% of the total collection. Silicified wood is a distant second at 12.2%. Chert is 3.8% of the collection,

chalcedony is 2.1%, quartz is 0.5% and the category "other" is 1.6%. This latter category consisted primarily of silicified siltstone. Thus, fully 92% of the raw material usage at the site involved quartzite or silicified wood.

All of these raw materials are of local origin. More exotic materials are exceedingly rare. Two small pieces of obsidian have been recovered. The results of a source analysis are still awaited. There is also a large knife river flint biface in the Sheptycki collection. Some form of extra-local contact, quite possibly trade, accounts for these occurrences.

Results of Excavations Carried Out Under Project 79-41

In the spring of 1979, Pollock initiated excavations on eleven 2 x 2 metre excavation units at FjPi-29. This work was carried out to assess the effectiveness of a magnetometer survey and to compliment work done in 1978. In 1978, Newton and Pollock (n.d.) reported that the Strathcona Science Park archaeological site seemed to be a single component, Oxbow lithic workshop, notwithstanding the location of the site and the volume of material being produced. The centre piece of this demonstration was a cluster analysis of raw material usage in each of the 2 x 2 metre units excavated in 1978. Because the dendrogram produced showed considerable similarity between the units, it was argued that evidence existed for regarding FjPi-29 as a single component Oxbow site. The cluster analysis undertaken is hardly definitive, however. Indeed, the dendrogram is marked by substantial "chaining" between cluster, indicative of similarity. More to the point is the question of why any other result would have been expected. Fully 92% of the assemblages recovered in all of 1979 are either petrified wood or quartzite. Quartzite constitutes nearly 80% of the assemblage. As long as quartzite and petrified wood were being quarried at FjPi-29, and this is a reasonable assertion throughout the site's prehistory,

then we should have every expectation that a comparison of raw material usage in excavation units would reveal a great deal of similarity.

The spring of 1979 excavations did lead to the discovery that the site was multi-component in nature. A historic coal mining component related to turn-of-the-century activities was recognized. A single ceramic neck sherd with exterior cord-marked impressions was suggestive of Late Prehistoric Period occupation (Figure 30). W. Byrne (personal communication) regarded this specimen as typical South Saskatchewan Basin Complex pottery, perhaps a late variant estimated to be in use from A.D. 1000 to the 19th century. A brown chert projectile point closely resembled Besant styles and suggested occupation in the time range of 300 B.C. to A.D. 700. Finally, an Oxbow component from 1978 continued to be recognized. The formal affinities of FjPi-29 projectile points will be discussed in a subsequent section. It should be noted at this time that the 1978 specimens were far from classic examples of Oxbow styles.

Gibson (n.d.) has reported the results of his magnetometer survey, and the results of follow-up archaeological work during the 1980 field season will be reported on in the future. H. Pyszczyk (personal communication) is unconvinced of the value of this application. Over the last two years, anomalies indicated by that survey have turned up largely negative results. It has frequently been the case that pieces of metal are the source of the anomaly. This serves only to heighten the impression of overall disturbance at the site.

Excavations carried out under 79-41 yielded 4,111 artifacts. Of this total, 52 items are finished or unfinished artifacts or fabricators. Quartzite artifacts make up 57.7% of these specimens, which included 9 bifaces, 6 biface fragments, 1 uniface, 1 uniface fragment, 1 edge modified flake, 8 split pebbles (5 of these were chert), 9 cores, 3 hammerstones, 3 projectile points, 5 scrapers and 2 biface preforms. The 4,059 items of debitage were made up of 3,097 (76.3%) quartzite items, 4 (0.1%) chalcedony items, 121 (3.0%) chert items, 740 (18.2%)

silicified wood items, 13 (0.3%) quartz and 84 (2.1%) "other" items. Debitage was categorized as 3,619 (89.2%) flakes, 152 (3.7%) cortex flakes, 17 (0.4%) partial cortex flakes, 152 (3.7%) shatter, 33 (0.8%) spalls, 8 (0.2%) split cobbles, 77 (1.9%) split pebbles and 1 unmodified cobble (see Plates 6, 7 and 8).

Finished Artifacts and Fabricators From Fall 1979 Excavation

Work conducted by Ives under Permit Number 79-109, resulted in the recovery of 370 finished artifacts, partially finished artifacts, fragments there-of and fabricators. This data is summarized in Table 2. Because of severe constraints on time and facilities, it is possible here to provide direct commentary and metrics on only projectile points plus 330 artifacts recovered during the exit gate excavation.

Small Bifaces:

Two complete small bifaces and eleven small biface fragments were recovered under Permit Number 79-109. Eight of these are fashioned from quartzite; one is of chert and two are of silicified siltstone. Three small bifaces were recovered under 79-41. Two are fragments of quartzite specimens while one is of chert and is complete. With one exception, these are regarded as projectile points. Transverse fracture of the blade above the haft element is the most frequent form of breakage and this occurs in seven cases. A series of attributes are recorded in Table 3.

FjPi-29:4220: This is an unfinished quartzite specimen made on a flake still bearing cortex on its dorsal surface. Flaking has principally taken the form of edge retouch, and is entirely unifacial (dorsal surface as well). The blade of the specimen is all that remains, with an apparent transverse fracture above the area in which a haft element might have occurred. Retouching had created symmetrical excurvate edges and a sharp point (not figured).

FjPi-29:4289: A small, complete brown chert projectile point. This specimen is rather squat and exhibits U-shaped side notching. There is a distinct tendency for the shoulders to be barbed, while the base is slightly convex. Both left and right lateral edges are essentially straight; the tip of this point is somewhat blunt (see Figure 34c).

FjPi-29:5860: The distal portion of a finely made grey quartzite point. All traces of the haft element are missing, and the specimen could come from a number of time periods. This item is comparatively long and narrow, with excurvate edges and a sharp tip (see Figure 34d).

FjPi-29:6280: The basal portion of a pink quartzite small biface. This specimen is effectively stemmed, with in-sloping shoulders which make a gradual transition to the small portion of the blade, still intact. Two larger flakes have thinned the stem, the left lateral edge of which is also broken (see Figure 35g).

FjPi-29:6282: The basal portion of a pink and grey small biface. Like the specimen above, this has fractured transversely across the blade. This specimen tends to be slightly corner-removed. The base is basically straight and exhibits heavy grinding. Blade edges appear to have been excurvate (see Figure 35f).

FjPi-29:6283: Figured in Figure 35e is another incomplete specimen of pink chert. Again, there is a fracture across the blade. While distinctly similar to the specimen just discussed, 6283 tends more toward a corner-removed type of notching. The base is heavily ground and thinned.

FjPi-29:6284: This is a complete pink and grey quartzite projectile point. There is a very slight asymmetry, with the left lateral edge being perceptibly more excurvate than the right edge. The base is marked by fairly broad, U-shaped notches. The tip comes to a fine point. While somewhat different, this specimen is not far removed from the last two items discussed in Figure 35e.

TABLE 2: FINISHED AND PARTIALLY FINISHED ARTIFACTS AND FABRICATORS, ALL PERMIT NUMBER 79-109 EXCAVATIONS (IVES), FjPi-29

	Raw Material						
Category	Quartzite	Chalcedony	Chert	Silicified Wood	Quartz	Other	Total
Projectile Points and Fragments	8	-	-	-	-	2	11
Bifaces	14	-	-	-	-	-	14
Biface Fragments	41	-	-	-	1	1	43
Unifaces	18	1	4	-	-	-	23
Uniface Fragments	10	1	-	-	-	-	11
Edge Modified Flakes	70	4	17	6	-	1	98
Bipolar Split Pebbles	20	6	50	3	2	7	88
Cores	43	2	1	2	2	1	51
Hammerstones	11	-	-	-	-	-	11
Anvils	14	-	-	-	-	2	16
Other	3	-	-	-	-	1	4
Total	252	14	73	11	5	15	370

TABLE 3: SMALL BIFACES, 1979, FjPi-29

Artifact No.	Basal Grinding	L(mm)	Bw(mm)	Th(mm)	S/Ba(mm)	SL(mm)	BL(mm)	NW(mm)	Wt(mm)	Indices W/L	Th/W
FjPi-29:4220	N/A	(24.9)	(21.3)	4.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FjPi-29:4289	Heavy	23.5	20.8	5.0	20.5	8.5	15.0	20.0	2.5	0.89:1	0.24:1
FjPi-29:5860	N/A	(45.0)	19.8	(5.3)	N/A	N/A	N/A	N/A	(5.6)	N/A	N/A
FjPi-29:6280	Heavy	(14.8)	N/A	(5.7)	N/A	N/A	N/A	13.1	N/A	N/A	N/A
FjPi-29:6282	Heavy	(22.0)	20.2	6.5	16.4	10.0	N/A	14.4	N/A	N/A	0.32:1
FjPi-29:6283	Heavy	(18.1)	16.1	5.3	13.6	8.7	N/A	10.1	N/A	N/A	0.33:1
FjPi-29:6284	Heavy	36.1	22.7	7.0	18.4	10.3	25.8	10.8	5.9	0.63:1	0.31:1
FjPi-29:6285	Heavy	(21.7)	17.2	6.4	16.1	10.5	N/A	13.7	N/A	N/A	0.37:1
FjPi-29:6286	Absent	(25.8)	24.2	3.9	(23.0)	(9.8)	N/A	N/A	N/A	N/A	0.16:1
FjPi-29:6287	Moderate	37.2	25.0	6.6	19.4	11.1	26.1	19.0	7.3	0.67:1	0.26:1
FjPi-29:6288	Heavy	(16.7)	(20.2)	(5.0)	19.2	N/A	N/A	18.3	N/A	N/A	N/A
FjPi-29:6289	Light/ Absent	(22.2)	(18.6)	(5.3)	16.4	12.0	N/A	16.1	N/A	N/A	N/A
FjPi-29:10454	N/A	(19.8)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FjPi-29:15222	Moderate	(16.5)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SL - Stem Length (to beginning of blade)

BL - Blade Length (total length less haft element)

NW - Neck Width (width between notches or at distal end of stem)

S/Ba - Basal or Base of Stem Width

L - Total Length

Bw - Blade Width

Th - Thickness

Wt - Weight

() - Incomplete specimen

FjPi-29:6285: This item closely matches FjPi-29:2682 and 6283. It was made on a fairly thick piece of quartzite and tends also to be corner-removed. The base is convex and severely ground. The left and right lateral edges would appear to have been excurvate, although this specimen also has a transverse fracture (see Figure 35d).

FjPi-29:6286: A particularly thin and finely flaked grey quartzite small biface which seems to have been broken in the final phases of manufacture. The distal tip is missing. The edges and base of this specimen remain sharp and are unmodified. There is a basal concavity and the left lateral edge has a broad U-shaped notch. There is no notch on the right edge. The left "ear" of this item retains a granular area which is either cortex or an inclusion of impurity (see Figure 35h).

FjPi-29:6287: Figured in Figure 35k, this item is somewhat unusual. In outline, it appears to be a projectile point. The base consists of a shouldered stem, the stem itself showing a slight concavity. The lateral edges are more or less straight. The distal end is irregular and may have been fractured since the tip is distinctly assymmetric toward the left. In fact, this portion of the specimen has been unifacially retouched to create a bevelled working surface with an edge of 40 - 45 degrees. The distal edge of this surface does appear to have traces of use wear. The specimen consists of grey quartzite with a white granular impurity.

FjPi-20:6288: The base of a small biface with a distinct basal indentation (U-shaped). The raw material appears to be silicified siltstone. The right lateral edge (to the left in Figure 35i) is excurvate from a slight shoulder, while the left lateral edge may have been straight.

FjPi-29:6289: A biface similar to that described above, lacking the distal portion. Shown in Figure 35j, it is fashioned from a pink quartzite. Ever so slightly shouldered, this specimen is indistictly ground at best and stands in contrast to 6288 in that regard. There is fine

flaking with slight assymmetry toward the left lateral edge. The basal indentation is not so pronounced.

FjPi29:10454: The midsection of the blade of a small biface made of silicified siltstone (see Figure 35c).

FjPi-29:15222: A portion of the base of a small quartzite biface no doubt resembling specimens such as 6283. Grinding and basal thinning is evident on this small fragment (Figure 35b).

FjPi29:7515: Possibly the base of a Middle Prehistoric style projectile point. The specimen is made of mudstone and shows dorsal flaking. This assignation is highly speculative (Figure 35a).

One case of transverse fracture appears definitely attributable to breakage during manufacture (FjPi-29:6286). FjPi-29:2680 seems to have been broken by force applied on the dorsal face, an impact which created a distinct cone. The remaining specimens could quite easily have been broken through use, although it is difficult to rule out all possibility of breakage during manufacture.

Newton and Pollock (n.d.:27) based their assessment of FjPi-29 as an Oxbow component on the formal affinities of three specimens (FjPi-29:2452, 3127 and 3240) with projectile points from the Harder Site in Saskatchewan (Dyck 1976) (see Figure 34a, b, c). They do remark that the specimens are by no means "classic" Oxbow, and this is certainly so. FjPi-29:2452 is particularly crude, and while it does resemble a Harder Site specimen, there is little else to go on. Both FjPi-29:3127 and 3240 appear to me to be quite typical of McKean Complex projectiles. The latter compares favourably with the Duncan form, while the former is reminiscent of Hanna specimens (cf. Wheeler 1954; Brumley 1975:163). FjPi-29:2452 could equally well be seen to fall into this range of variation.

The 1979 excavations produced three distinct groups of projectile points. Best represented were examples of different McKean varieties.

In spite of slight shouldering normally associated with Duncan forms, both FjPi-29:6288 and 6289 bear remarkable similarity to McKean Lanceolate varieties. And despite its ultimate function as an endscraper, FjPi-29:6287 is crude but definitely Duncan in its overtones. I would also be prepared to argue that the base of FjPi-29:6280 is Hanna-like (see Brumley 1975:163).

A second distinct group is comprised by FjPi-29:6282, 6283, 6284 and 6285. All of these specimens can be seen to fall into the range of formal variability typical of Besant (e.g. Reeves 1970:163; Quigg 1974: 71; W. Byrne, personal communication). The size range, thinning and heavy grinding of the base, and variable style of notching all suggest this type. Two other specimens should be mentioned in this regard. FjPi-29: 4289 is also distinctly Besant-like. This is tempered by the somewhat barbed shoulders which might be taken to be similar to some Pelican Lake specimens (Reeves 1970:163, Plate 22:21). However, both this and Pollock's 1978 specimen, FjPi-29:610 (Plate 9f), are best ascribed to Besant workmanship.

Finally, FjPi-29:6286 appears to be the first excavated evidence for an Oxbow occupation of the site. Though clearly unfinished, the single, ear-like projection created by side-notching and a basal concavity is reminiscent of the hallmark of this style of projectile. I will not broach, here, issues occasionally raised concerning the formal typological and prehistoric relationships suggested between McKean and Oxbow forms and complexes.

These remarks can be supplemented most effectively by specimens from the Sheptycki and Devlin amateur collections recently acquired for analysis by the Archaeological Survey of Alberta. McKean Complex forms predominate, but also present are two classic Oxbow specimens, Besant projectiles and Late Plains triangular projectiles. Pyszczyk excavated an unusual small specimen this summer which might be regarded as Pelican Lake (personal observation).

In terms of distribution, FjPi-29:6286 comes from Unit C on the Picnic Pavillion Bicycle Path, while FjPi-29:6285 came from the laboratory/display building area excavation. Seven other small bifaces of diagnostic significance came from the 8 x 8 and 4 x 4 metre units. FjPi-29:6280, 6282 and 6284 came from disturbed contexts within the 4 x 4. FjPi-29:6287 occurred in the same area in partially disturbed soils and FjPi-29:6288 came from an undisturbed context in the 4 x 4. FjPi-29:6283 and 6289 were found in the southeast quadrant of the 8 x 8, the former in disturbed context, the latter apparently undisturbed. The distribution through different levels tends to obscure any spatial patterning which might be present. I do draw the reader's attention to the tendency for McKean Complex materials in the 8 x 8 and 4 x 4 to occur in deeper levels and partially or undisturbed contexts, while Besant forms occur in surface and disturbed levels. Two principal periods of usage could be postulated for this area of the site, although this course is fraught with difficulties created by disturbance.

Bifaces and Biface Fragments:

Remarks made here are limited because an analysis of all the bifaces recovered by excavation from FjPi-29 will be supplemented by specimens from an amateur's collection and will be given more detailed analysis in the near future. Twelve complete bifaces were recovered in the exit gate area and metrics are reported in Table 4. Sample specimens appear in Figures 36, 37 and 38. All twelve complete specimens were of quartzite. Note that these specimens are on the average slightly smaller than those reported by Newton and Pollock (cf. n.d.:37). A total of 38 biface fragments were also recovered. Of these, one was of quartz, one was of "other", and 39 were of quartzite. Included among these was the basal half of a grey quartzite hafted biface figured in Figure 35m.

In the forthcoming analysis, the size range and surface morphology of bifaces will be regarded as an important source of data relevant to

debitage analysis. Most bifaces are rejects, blanks or preforms, although two of the complete specimens are asymmetric, finely retouched and seem used (FjPi-29:6292, 6299). FjPi-29:6292 is shown in Figure 33 while FjPi-29:6299 is shown in Figure 37. Figure 38 is of FjPi-29:8197. Bifacially shaped, this specimen is an elongate trapezoid in form. The edges are laterally ground, with one end showing pronounced step flaking to the right in Figure 38. This specimen seems to be an adze (F. Bordes, personal communication). In spite of these latter specimens, there must have been highly selective pressures placed on the bifaces created, and it is recognized that expediently treated debitage is more apt to reveal the nature of the artifacts actually produced and used.

Unifaces:

For the purpose of this analysis, unifaces were given the provisional definition of those specimens exhibiting one or more margins where a bevelled edge had been created by both primary and marginal retouch. As such, this category includes specimens commonly referred to as endscrapers and sidescrapers, as well as large unifacial flake and spall tools. There were 20 complete unifaces and 10 fragments. Twenty-four (80%) of these were quartzite, while 2 were of chalcedony and 4 were of chert. Four edge morphologies were manifest: straight, convex, straight/convex and concave/convex. Fourteen specimens were convex, 3 were straight, 11 were straight/convex and 1 was concave/convex (N=29). The mean edge angle, calculated from means of the range measured for each specimen (N=28) approached 60 degrees.

Metric attributes for the complete unifaces are presented in Table 5, and sample specimens are shown in Figures 39 and 40. There are essentially three morphological classes of unifaces present, endscrapers (7), sidescrapers (3) and unifaces on spalls (10). Mean values are presented separately. Some of the small chert endscrapers were evidently fashioned from small (in fact, tiny) split chert pebbles. Unifacial tools are fairly well represented in this area of the site, although they are comparatively rare forms at FjPi-29.

TABLE 4

MEAN VALUES FOR COMPLETE BIFACES, EXIT GATE, FjPi-29

Mean Length	Mean Width	Mean Thickness	Mean Weight
86.5 mm	60.6 mm	22.7 mm	156 gm.

Length Range = 39.0 - 114.8 mm
N=12

TABLE 5

MEAN VALUES OF ATTRIBUTES FOR COMPLETE UNIFACES, EXIT GATE, FjPi-29

	Mean Length	Mean Width	Mean Thickness	Mean Weight
Endscrapers:	22.2 mm	17.0 mm	6.0 mm	2.3 gm
Sidecrapers:	30.5 mm	20.7 mm	6.0 mm	3.7 gm
Large Spalls:	81.3 mm	48.0 mm	17.6 mm	87.5 gm

Edge Modified Flakes:

This category yielded the greatest number of non-fabricator finished artifacts, constituting 26.1% (N=86) of the exit gate sample. Edge morphology was divided into the following categories: irregular, straight, convex, concave, straight/convex, straight/concave and straight/concave/convex (three working surfaces with different configurations on a single flake). There was 1 (1.2%) irregular edge, 36 (42.9%) straight edges, 33 (39.3%) convex edges, 6 (7.1%) concave edges, 6 (7.1%) straight/convex edges, 1 (1.2%) straight/concave edges and 1 (1.2%) straight/convex/concave edge.

Not all specimens allowed accurate edge angle determinations. Of those that did, a significant range of variation was invariably present on individual flakes (as much as 25 degrees). In only two cases did edge angle measurements dip below 45 degrees, with several near vertical angles being recorded. I would anticipate that a mean value for this sample would be on the order of 60 degrees. Other mean dimensional values are presented in Table 6.

TABLE 6

MEAN VALUES OF ATTRIBUTES FOR EDGE MODIFIED FLAKES, EXIT GATE, FjPi-29

Mean Length	Mean Width	Mean Thickness	Mean Weight
43.9 mm	31.7 mm	10.6 mm	41.4 gm

Length Range = 15.2 - 161.0 mm
N=84

Straight or convex edges were clearly favoured, although the implication of this is less than clear. Evidently spokeshave-like concavities were not the desired form. The presence of a considerable number of edge modified flakes does indicate that expedient tasks not directly related to lithic manufacture were also being carried out. These could very well be related to associated activities such as hafting newly manufactured specimens. At the same time, they could be the residue of more diverse activities from domestic occupation. Of course, edge modified flakes could also have been a manufacturing objective. However, 21 (24%) specimens had macroscopic traces of use wear, a fact more in line with the points made above.

Cores and Core Fragments:

A total of 48 cores and core fragments were discovered during the fall of 1979 in the exit gate area. Quartzite clearly predominates in raw materials, encompassing 43 (89.6%) of the specimens. There was one chert, two silicified wood and one "other" core. The cores included extremely large cobble fragments such as FjPi-29:11286, which weighed 1,629.6 grams and had dimensions of 219.0 x 127.0 x 58.8 millimetres. Cores and core fragments the size of split pebbles were more common, however, Some specimens tended to be discoidal in form. Most were large slabs driven from cobbles, or more amorphous and angular cobble fragments from which flakes had been driven. This latter category was quite common and suggest that more than one pathway of cobble reduction created the debitage present at the site. Sample specimens of cores are presented in Figures 41 and 42.

Bipolar Pebble Cores:

Mean values for the bipolar pebble cores are presented in Table 7. Of the 84 specimens in the sample, 19 are of quartzite, 5 are of chalcedony, 48 are of chert (largely black), 3 are of silicified wood, 2 are of quartz and 7 are of "other" materials. Chert pebbles have a

disproportionate representation in this sample (57.1%) in as much as chert constitutes only 3.8% of the total 1979 collections. Not considering the category split pebbles, some 7.8% of the finished artifact and fabricator assemblage consists of chert. The slight over-representation quite likely stems from the use of bipolar split pebbles which are largely non-quartzite. This minor component of the assemblage appears to be the only other significant source of raw materials. The majority of pebbles in this collection strike me as discards of fairly clean breaks -- there is little in the way of morphology which suggests use as wedges. A selected sample of split pebbles appears in Figure 43.

TABLE 7

MEAN VALUES OF BIPOLAR PEBBLE ATTRIBUTES, EXIT GATE, FjPi-29

Mean Length	Mean Width	Mean Thickness	Mean Weight
35.8 mm	24.7 mm	13.1 mm	16.9 gm

Length Range = 10.5 - 72.0 mm
N=84

Hammerstones:

Hammerstones exhibited pitting and pecking on the surface of their extremities. Nine examples were recovered in the exit gate area. These were all quartzite. Mean values are presented in Table 8. A fair size range is present, although these specimens are distinctly smaller than those reported upon by Pollock and Newton (n.d.:63-64). As the mean dimensions suggest, there is a tendency for these specimens to be ovoid or cylindrical in form. A selected sample of hammerstones appears in Figure 44.

TABLE 8

MEAN VALUES OF HAMMERSTONE ATTRIBUTES,
EXIT GATE, FjPi-29

Mean Length	Mean Width	Mean Thickness	Mean Weight
68.9 mm	52.4 mm	48.2 mm	170.0 gm

Length Range = 47.5 - 85.9 mm
Weight Range = 57.6 - 421.1 gm

Anvils:

A total of 16 anvils were recovered. Anvils exhibited pitting or crushing on one or more surfaces which presented a suitable platform on which cores could be rested. Twelve of these specimens were quartzite and two were granitic. Six complete specimens were examined for the measurements presented in Table 9. Representative anvils are figured in Figures 45 and 46. The possibility should not be ruled out that items classed as anvils were also hammerstones. As has been suggested elsewhere (Losey 1971), there is some likelihood that quartzite hammerstones and anvils were cannibalized upon breakage. A number of cortex flakes suggest this outcome by virtue of signs of surface pitting.

TABLE 9

MEAN VALUES OF ATTRIBUTES FOR ANVILS,
EXIT GATE, FjPi-29

Mean Length	Mean Width	Mean Thickness	Mean Weight
190.5 mm	90.9 mm	69.1 mm	1222.1 gm

N=6

Unusual Specimens:

A few specimens in the collection are not suited to ordinary functional or morphological terms. Specimen FjPi-29:6548 has been bifacially chipped (Figure 47). Although fragmentary, a broad side-notching is visible along the complete lateral edge. This is a large specimen (160.0 mm to 67.8 mm x 33.6 mm) which was no doubt a figure eight shape in outline. A complete specimen of this sort is present in the Sheptycki collection. While this item might be regarded as a maul, wear on one distal surface suggests it might have functioned as a quarrying implement. A small number of flakes from the site exhibited extensive dorsal wear, a phenomenon less easily accounted for.

Historic Artifacts:

Pollock's 1979 excavations resulted in the recovery of three pieces of metal. These included two rusted pails and one metal fragment. Nineteen historic items were recovered by Ives. Among these were six pieces of metal (tin cans, bottle caps and wire), one piece of brick, two .22 calibre shell casings, one nail, one fragment of painted wood, four plastic items, three glass bottles and one coin.

The last specimen is perhaps the most interesting. It is a ten-cent piece issued in 1901 for the Straits Settlements. This was the last year of Victoria's reign and 2.7 million of these coins were minted. Consisting of 80% silver, this coin would be valued at roughly $1.75 if it were in mint condition. I cannot locate a mint mark on this specimen, although it almost certainly would have been minted in Bombay or England. The Straits Settlements were a crown colony on the Malay Peninsula and were formed in 1826 when the territories of Singapore, Penang and Molucca were combined (Maurice Doll, personal communication; Krause and Mishler 1977:1012-1014). Precisely how the coin came to be on the site is somewhat of a mystery. It was excavated from disturbed matrix in the exit gate area.

The glass bottles, collected from a foot path in the valley below the site, involved two liquor bottles and a patented medicine bottle. The latter is made from clear glass and is of three piece mold manufacture. A flat basal portion forms the bottom of the mold. The embossments on the lateral sides of the bottle advertise Cha. W. Fletcher's Castoria. This type of manufacture, a Ricket mold, can be assigned a post-1880 date of manufacture. One of the other two specimens is a green wine bottle, with heavy bluish white patina. It has an applied finish and the kick-up base of a "French Wine" or champagne stye bottle. Since horizontal turn marks are present on the finish, a post-1880 manufacture date is suggested. Finally, the last specimen is a clear glass bottle with maganese oxide tint. This flask has an applied finish and two molded portions form the body of the bottle. The bottom of the bottle is flat, although the base varies in thickness. A turn-of-the-century date is reasonable in this case also (K. Hardie, personal communication).

In general terms, we can specify that historic artifacts such as those just discussed are most likely associated with turn-of-the-century coal mining operations in the Strathcona area. More recent articles relate to sanitary landfill operations.

Summary of Finished Artifacts and Fabricators

This review of finished artifacts and fabricators suggests several salient points. It is absolutely clear that this site has been occupied during both the Middle and Late Prehistoric periods. While Oxbow projectiles are present, the McKean Complex forms are most numerous. Besant is the best other represented style, but ceramics and Late Plains points indicate even more recent occupation. Numerous transverse fractures of projectile points raise the possibility of breakage during use. Acknowledging the severe disturbance in the exit gate area, it is still possible that concentrations of small bifaces result from loci at which discard and rehafting took place.

The fairly high number of edge modified flakes, a significant portion of which have been used, may point to wood and bone modification associated with lithic manufacture. Recall also the presence of an adze. The comparatively few scrapers, especially the small chert endscrapers, may have been one class of tool being fashioned for similar purposes.

The presence of split pebbles and other kinds of cores highlights the need to recognize that debitage was created in several ways. Discarded bifaces are an important source of data concerning the specific process of bifacial reduction. However, a strong selection gradient out of the site for all forms of blanks, preforms and finished bifaces is anticipated. Because of its expedient nature, debitage is regarded as the best record of the reduction sequence.

Debitage Sample

Methods:

To consider the entire debitage collection would of course have been a gargantuan task. The most obvious solution to this dilemma was to sample the collection. The set-up of the original cataloguing system made enumeration of each specimen for sampling a time-consuming venture as well. For this reason, I opted to take a randomly selected sample of excavation units from the 8 x 8 metre and 4 x 4 metre units. The distribution of these units is presented in Figure 18. The units are listed in Table 10. A total of 16 units were selected from the 8 x 8 metre block, while 4 units were selected from the 4 x 4 metre block. Selections were made separately for each of the two blocks.

The random selection of units (as opposed to individual artifacts) did facilitate sampling over the complete spatial distribution of artifacts. In fact, the 25% sample of spatially organized units realized a 22.1% sample of the total number of debitage items in the 8 x 8 and 4 x 4. The sample group consists of 1,817 items from a total of

7,906 debitage items. It is comprised of 421 platformed flakes, 57 spalls and 1,339 pieces of shatter.

TABLE 10

RANDOMLY SELECTED UNITS FOR THE DEBITAGE SAMPLE, FjPi-29

17.0/17.0	18.0/17.0	19.0/17.5	20.0/18.0
17.5/15.0	18.5/14.5	19.5/15.5	15.5/19.0
17.5/16.0	18.5/15.5	20.0/15.0	16.0/18.5
17.5/18.0	18.5/18.0	20.0/17.0	16.0/19.5
18.0/16.5	19.0/16.0	20.0/17.5	16.5/20.0

The three debitage categories are defined as follows. Spalls fell into an arbitrary size range of greater than 50 millimetres and the dorsal surface bore some cortex.* Spalls were exclusively quartzite. Platformed flakes are specimens which have complete striking platforms and are distally complete. It is recognized that some broken specimens are difficult to distinguish from flakes which have a step termination. Shatter included all other debitage lacking these diagnostic features.

Shatter was then classed into one of two categories: those items without cortex and those items with cortex. Both spalls and flakes were subjected to a series of metric measurements and non-metric determinations. The metric attributes recorded were flake length, flake width, bulbar thickness, maximum flake thickness, platform width, platform thickness and platform angle. Flake length was the maximum dimension between the platform edge (normally the platform/dorsal surface juncture) and the distal end, at right angles to the platform. Flake width

* This is an artifical size distinction which will be abandoned in future work.

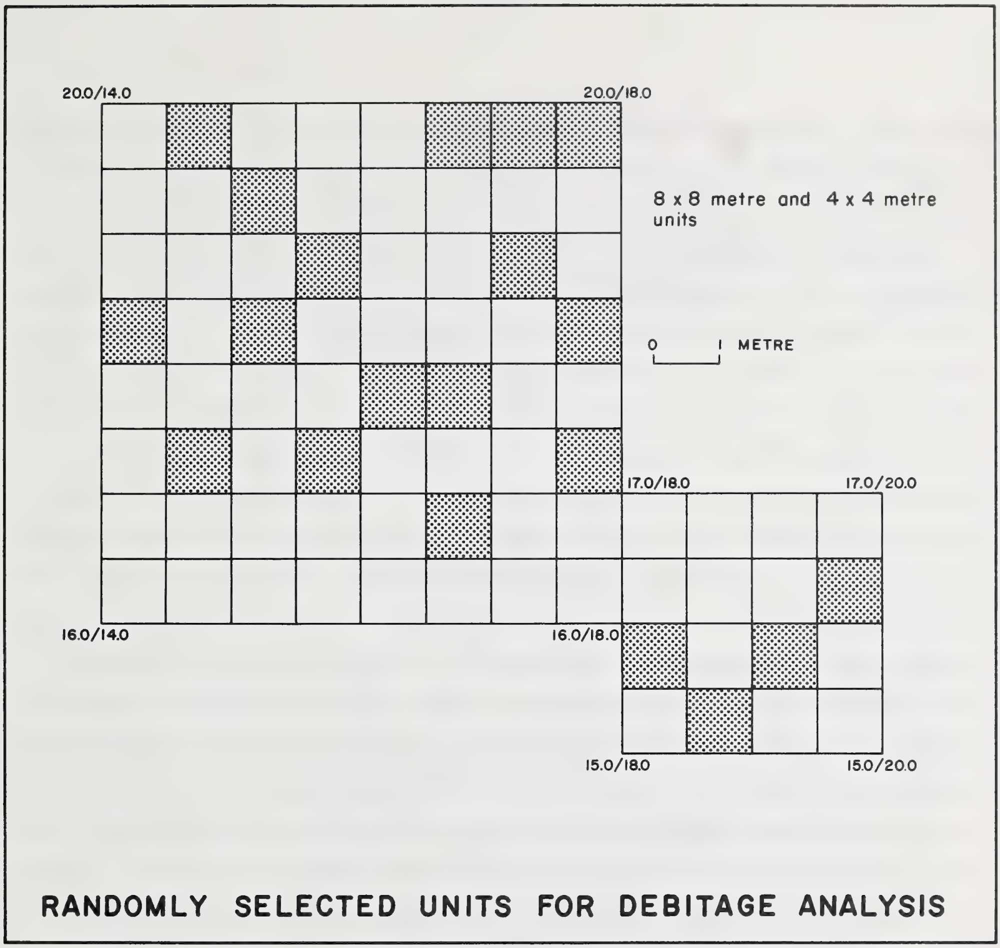


Figure 18: Units selected from a table of random digits for debitage analysis. All complete flakes and specimens of shatter from each unit selected were used in the analysis.

consisted of the maximum dimension between two parallel lines touching the lateral extremes of the flake at right angles to the flake length. Bulbar thickness was the maximum dimension through the flake at the thickest point of the bulb at right angles to the flake length and width dimensions. If the bulb was diffuse, this measurement was taken within one third of the distance from the striking platform. The maximum thickness of the flake consisted of the maximum dimension through the flake at the thickest point below the bulb, again measured at right angles to the flake width and flake length. If the bulb was diffuse, this measurement was taken within one third of the distance from the distal end of the flake. For the striking platform attributes, width involved the maximum dimension measured between the right and left lateral edge intersections with the platform. Platform thickness was regarded as the maximum dorso-ventral distance of the platform, taken perpendicular to the platform width as defined above. Finally, platform angle was that angle formed between the platform and the proximal portion of the ventral surface of the flake. Where there was pronounced dorso-ventral curvature, the second axis consisted of a line passing through the ventral face of the flake.

There were four major non-metric attribute categories. For the striking platform category, three features were considered. These were platform type, platform shape and attributes associated with the platform. This latter group included lipping and platform modification (such as grinding). Basic geometric shapes were used for describing the platform, including circular, ellipsoidal, quadrilateral, triangular and other. The platform types were cortex, plain (formed by a single flake), bifacial thinning (only those platforms with two or more distinct facets), cleavage plane and other. The second major category was that of dorsal morphology. Four attribute states were recognized. These were 100% cortex, 50% to 99% cortex, 1% to 50% cortex and no cortex. The third major category was longitudinal section, in which the attributes were straight, concave, convex and irregular. In a concave longitudinal

section, the long axis of the flake when viewed from the side was concave ventrally and convex dorsally. The opposite was true of convex longitudinal sections. The final major category was that of flake termination. The distal attributes recorded here were feathered, stepped, hinged, outrepassé, broken and irregular. The first four categories are as defined by Crabtree (1972).

Results:

An intensive analysis of these and other attributes is under way, and only provisional results are presented. For the metric attributes, I will confine my remarks to quartzite items only. Silicified wood fractures in a peculiar fashion governed by longitudinal planes within the material. Chert and other raw materials are scarce. By removing all materials other than quartzite from consideration, we are allowed a fair approximation of the process of cobble reduction. The only other significant source of raw material appears to be that of split pebbles, and there only 22.6% (N=19) of the artifact sample is quartzite. Thus, only a tiny percentage of quartzite debitage should be related to anything other than cobble reduction.

A summary of the metric attributes for platformed flakes from the sample units in the 4 x 4 and the 8 x 8 is presented in Table 11. Spalls are excluded. Generally speaking, the standard deviation for each attribute is high, indicating a considerable range of variation within the sample. Bulbar thickness and maximum flake thickness are seen to be near duplicates. Of note is the fact that the mean value for flake length is actually shorter than that for flake width. Coupled with the knowledge that the vast majority of quartzite flakes terminate in step fractures, two implications are suggested. Obviously, cobble quartzite leaves something to be desired as a raw material. To go a step further, this fact may suggest that bifacial thinning was the predominant class of activity. There is some evidence to indicate that the frequency of hinging increases as a biface nears completion (A. Nickelhoff, personal communication).

Operating under the premise that there is a strong correlation between size attributes of flakes, in Figure 19, I present a bar graph of quartzite flake lengths. In this case, two points should be made. First, the distribution is clearly and substantially positively skewed. The mean for the sample of 452 items analyzed (flakes and spalls) is 23.01 millimetres. Nonetheless, the mode is only in the 11.0 - 12.9 millimetre class, while the median is 16.40. Size classes less than 7 millimetres rather closely approximate the mesh size of the screen employed. Because it was necessary for excavation to proceed rapidly, it was not possible to recover these size classes by control bulk sampling or some other such procedure. It is worth noting that the drop-off begins with the 7.0 - 8.9 millimetre size class - specimens in this range are too large to have passed through the screen.

A bar graph with five degree intervals for the striking platform angle is given in Figure 20. Here, the distribution much more closely approximates a normal distribution. There is slight positive skewness for the sample of 414 items.* There is also a tendency toward a bimodal distribution, with peaks at the 110^{o} and 120^{o} class intervals.

It is hoped that a pairwise comparison of striking platform angles and length classes currently being prepared will provide a greater amount of information on the reduction process. For now, it is possible to conclude that while smaller flakes are by far the most common, there are significant percentages of much larger flakes present at a nearly constant frequency. A comparatively wide range of striking platform angles are present also. These seem to cluster more tightly about a central value. In sum, the loss of data concerning small flakes is unfortunate. We may suspect, however, that the drop-off in the 7.0 - 8.9 millimetre size range implies a genuine absence of this

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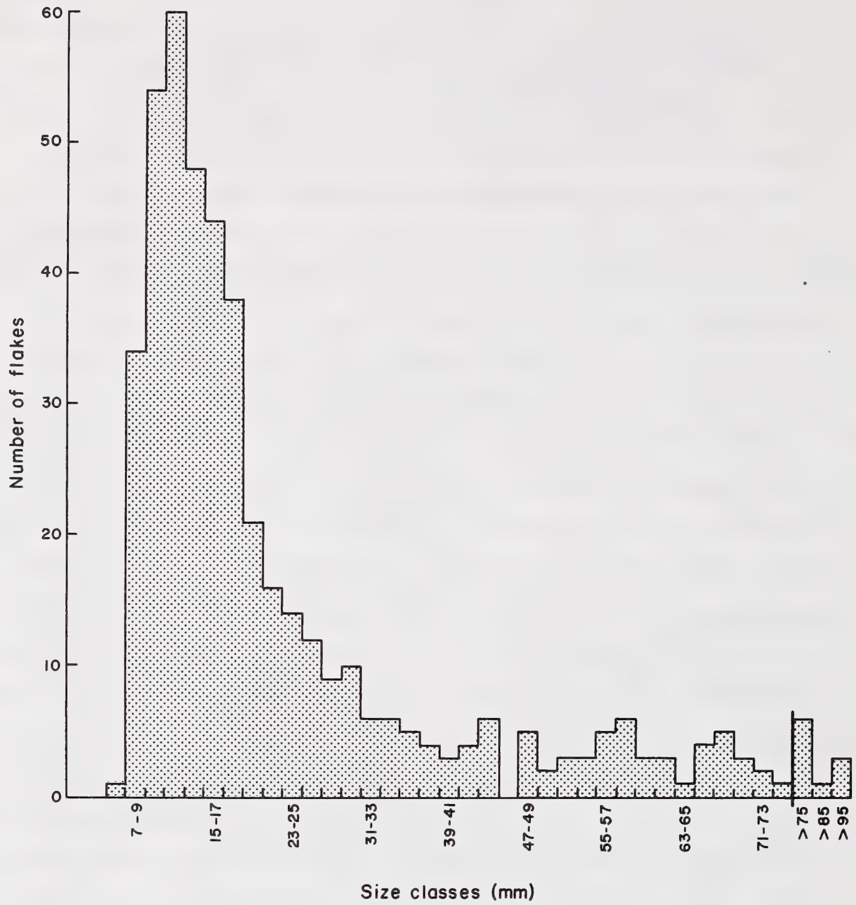
* This figure includes spalls. Not all platform angles on spalls could be measured as the force applied to fracture a cobble surface also tends to collapse the platform.

TABLE 11

SUMMARY OF METRIC ATTRIBUTES OF PLATFORMED FLAKES FROM UNITS SAMPLED IN THE 8 x 8 AND 4 x 4 METRE UNITS, FjPi-29

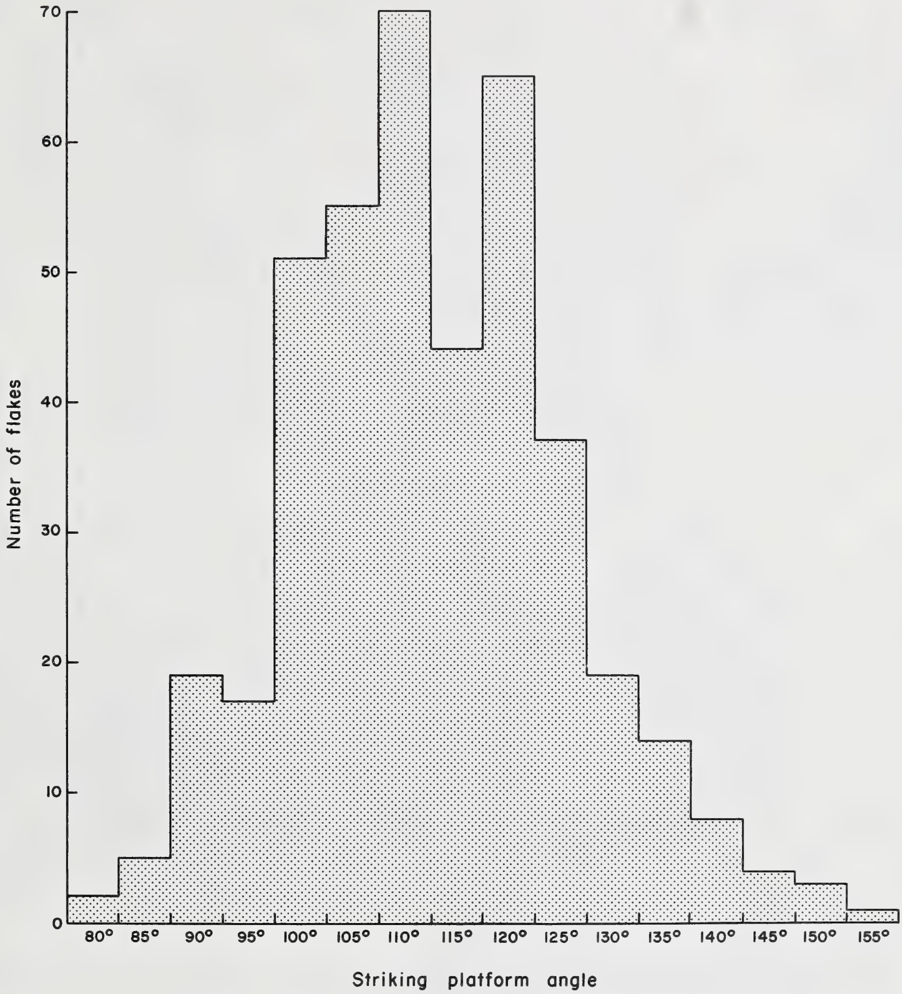
ATTRIBUTE	MEAN	STANDARD DEVIATION
Flake Length (mm)	17.3	9.0
Flake Width (mm)	19.1	8.9
Bulbar Thickness (mm)	3.9	2.3
Maximum Thickness Below Bulb (mm)	3.9	3.7
Flake Weight (gm)	2.3	3.8
Platform Width (mm)	9.9	6.3
Platform Thickness (mm)	3.0	2.2
Platform Angle (Degrees)	113.1	13.1

N = 395, spalls excluded. All flakes of quartzite



FREQUENCY OF FLAKE SIZE CLASSES FROM DEBITAGE SAMPLE, EXIT GATE EXCAVATIONS

Figure 19: Number of flakes plotted against flake size classes for the debitage sample acquired from the exit gate excavations. The size classes are based upon flake length.



FREQUENCY OF STRIKING PLATFORM ANGLES, DEBITAGE SAMPLE, EXIT GATE EXCAVATIONS

Figure 20: The distribution for 5^{o} degree increments in striking platform angles in the debitage sample. In this study the striking platform angle was regarded as that angle formed between the striking platform and the proximal portion of the ventral surface of the flake.

class. In that case, there is some evidence that the reduction process in this area of the site is truncated. In making this conclusion, we must be cognizant that several time periods may be incorporated in this sample. At the same time, shatter size ranges require further study to determine if smaller size ranges are common. The poor flaking qualities of quartzite might contribute to such an eventuality.

Non-metric platform attributes for quartzite flakes (exclusive of spalls) are presented in Figure 21.* Only three categories of platform type are well represented in Figure 21a. Plain striking platforms, or those formed originally by the detachment of one flake, are by far the most common. Cortex platforms are fairly well represented as are faceted platforms (likely most often the product of bifacial thinning).

There were two predominant platform shapes (Figure 21b). Ellipsoidal forms, typical of the platform configuration of bifacial thinning flakes, were most common. The category "other" was also well represented, and these consisted most often of a thin ridge. While this might be construed as related to bifacial thinning, it could also have to do with other procedures. For example, the large amount of force applied simply to detach quartzite flakes (particularly during decortification) creates a number of ridge-like platforms as the impact area collapses. Triangular outlines were moderately common; these could be related to the earlier phases of biface reduction, or equally well to the reduction of angular cores, i.e., cores which are not discoidal or bifacial in outline.

The results for dorsal morphology are shown in Figure 21c. This figure shows a steady progression from total cortex coverage to no cortex. If anything, those categories having most cortex seemed under-represented. On the other hand, the total presence of cortex may have been somewhat over-represented. Experimental flaking of cobbles carried out in conjunction with geological sampling of cobbles from the

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* Recorded for the same sample of 395 quartzite flakes.

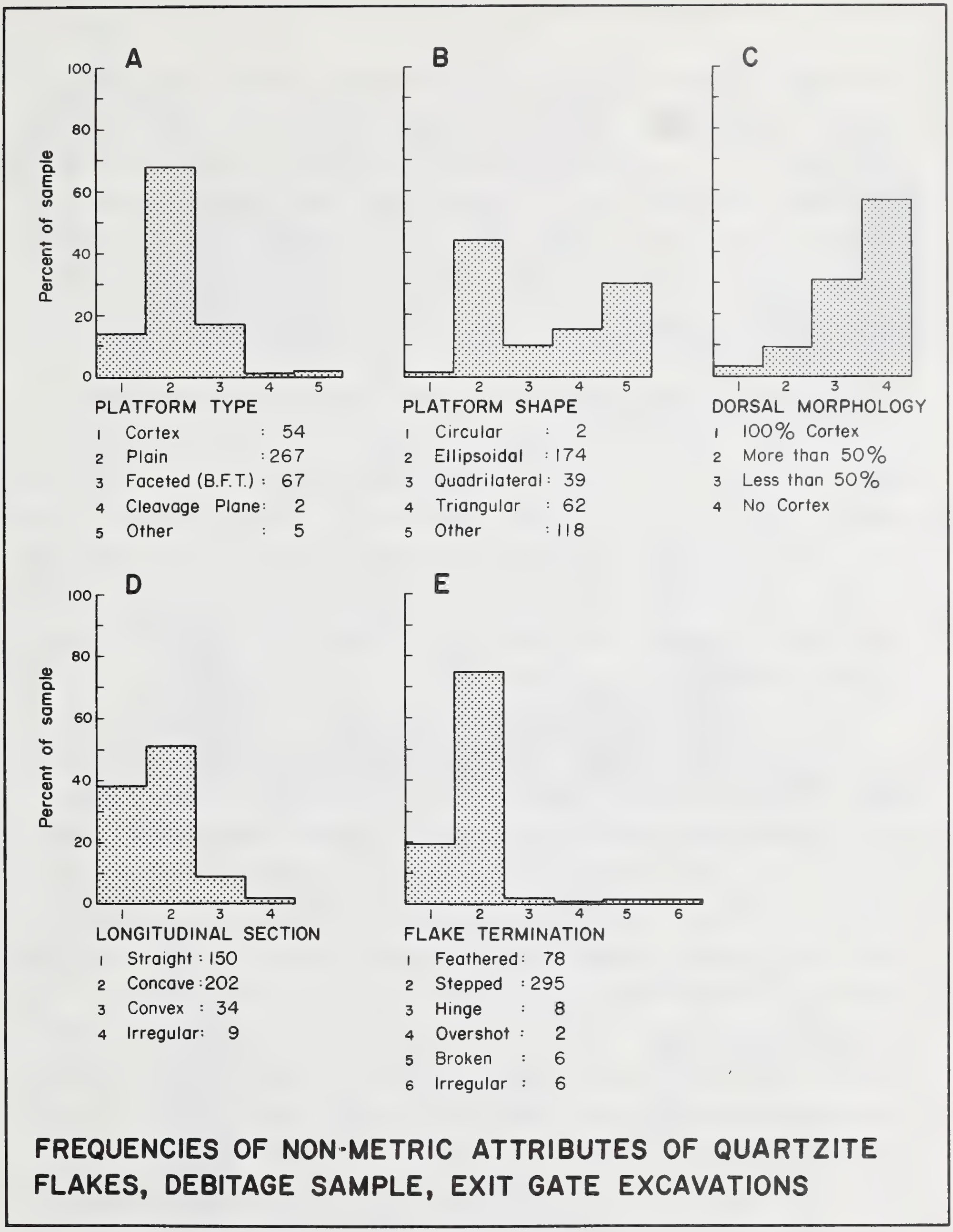


Figure 21: Bar graphs showing the relative frequency of non-metric attributes on quartzite flakes from the debitage sample, exit gate excavations.

Saskatchewan Sands and Gravels (to help relate surface area cortex to interior non-cortex volume) is being carried out to shed light on this issue. If it were true that primary cortex specimens were under-represented, one would have to suspect that initial cobble reduction was being carried out at some other location on the site. Perhaps this phase of work was actually carried out in the valley below the site, a situation which would have led to satellite extractive sites about FjPi-29.

Longitudinal sections were also dominated by only two forms (Figure 21d). Straight sections were common, while the greatest number of flakes were concave in longitudinal section. Interestingly enough, almost all of the latter class ended in step fractures. Both attributes reinforce the notion that bifacial reduction may have been the most typical technological event to take place at the site. Straight flakes could presumably occur early in biface reduction, or in entirely different forms of cobble reduction.

Flake terminations as well were unevenly distributed (Figure 21e). The vast majority were step terminations, with feathered terminations being a distant second. Terminations alone may not be particularly diagnostic of technological procedures. Feather terminations could obviously occur in a number of ways and at different stages of the reductive process. There are some grounds, however, for positing a direct relationship between decreasing thickness of biface or preform, decreasing platform angle, and frequency of hinge terminations.

The frequencies of platform associated attributes, lipping and platform modification, are shown in Figure 22. While not strictly correlated, one would anticipate the greatest association of these features with bifacial thinning activities. In Figure 22a, for platform type, lipping and platform modification are best represented on plain flakes and well-represented on faceted flakes. Lipping and platform modifications are distinctly associated with ellipsoidal and "other" (largely ridged platforms) platform shapes in Figure 22b. Again,

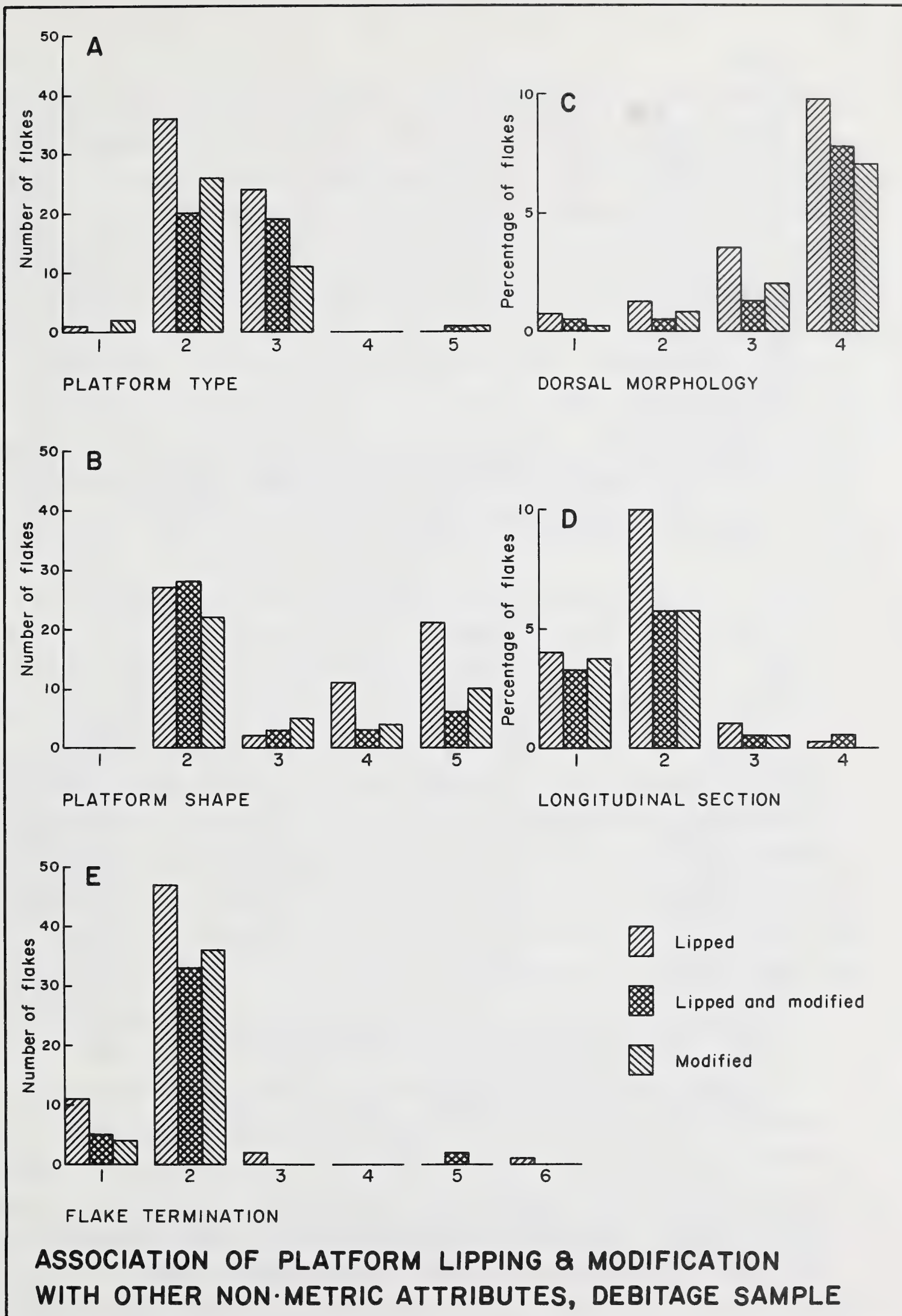
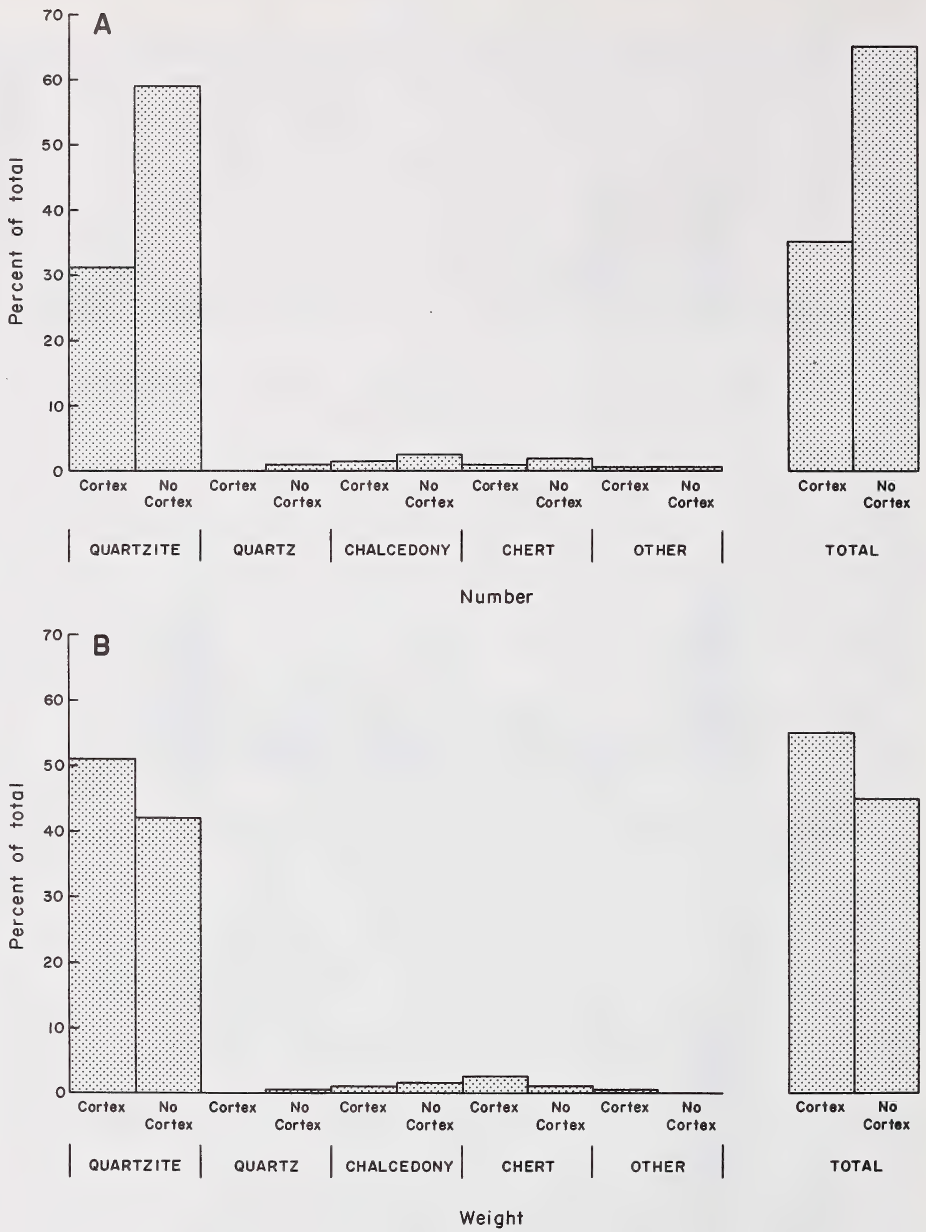


Figure 22: Bar Graphs showing the degree of association of platform lipping and platform modification with other non-metric attributes in the debitage sample. The number code under each graph is that listed for the same category in Figure 21.



FREQUENCY OF CORTEX COVERAGE ON SHATTER IN DEBITAGE SAMPLE, EXIT GATE EXCAVATIONS

Figure 23: Frequency of cortex coverage (presence or absence) on the shatter in the debitage sample given by number of specimens (A) and weight of specimens (B).

flakes entirely lacking cortex have the bulk of lipped and platform modified specimens (Figure 22c). The strong correlation of these features at each stage of dorsal morphology should not be overlooked. Flakes which were straight in longitudinal section had a significant association with lipping and platform modification (Figure 22d). Concave flakes held the clear majority of these features for this category, however. Note the predominance of lipped and platform modified flakes associated with step terminations (Figure 22e). In each case, those attributes putatively associated with bifacial thinning occur most commonly on classes of flakes most likely to be involved in the same process: faceted, ellipsoidal platforms, on non-cortex flakes which are concave in longitudinal section and which terminate in step fractures.

To conclude this brief summary, shatter was divided into cortex and non-cortex categories. This dichotomy is presented in Figure 23. Non-cortex flakes are clearly more numerous (Figure 23a); yet, the greater weight of material does involve pieces of shatter exhibiting cortex (Figure 23b). The analysis presented includes quartzite, quartz, chalcedony, chert and "other" raw materials. As with the combined results for all platformed flakes, there is a suggestion here that the total number of cortex forms may actually be over-represented in the collection. The evidence provided by shatter may be the more critical, again bearing in mind the difficulties of detaching complete quartzite flakes. A corollary of this line of reasoning might also be that the reductive process was somehow truncated at least in this area of the site.

In closing this section, I would like to note that preliminary work on pairwise comparison of non-metric attributes has been undertaken. This data already requires revision. It is already apparent, however, that when platform type versus cortex cover categories are plotted against total flake numbers, mean flake type weight, or total flake type weight, they provide useful graphic indices to reduction

activities. The ranking of categories such as plain striking platform/ no cortex as plotted against total numbers and total weight shows a high degree of similarity. The mean weight graph for similar information is strikingly different. Such a difference may point to heterogeneity in reduction sequences or the absence or over-representation of certain phases of reduction. Greater detail in the formation of categories and a body of research on experimental reduction sequences (as a guide to debitage production) are essential before conclusive results will be available.

The debitage analysis has perhaps served best to indicate that further research is badly needed. The data from the platformed flakes and shatter may yet contradict each other on the issue of over or under-representation of cortex flakes. Shatter must be more thoroughly analyzed for size classes and degree of cover. Since a great many quartzite flakes break upon detachment, shatter may actually be the best indicator. Nevertheless, to resolve objectively just how many cortex flakes should be expected, we will need data on mean cobble size and surface cortex/interior volume measurements. If cortex flakes turn out to be under-represented, I would suggest a close examination of the river valley for small stations at which decortification took place. Manuport cobbles found on the site do not favour this conclusion. If cortex flakes were to be over-represented, then we might suggest that complete reduction of cobbles did not actually take place at the site. Proportional representation could be viewed as evidence for the presence of an entire reduction sequence.

I do think there is already undeniable evidence that bifacial thinning of biface blanks and preforms were likely vital components of technological activity at the site. Split pebbles are clear evidence that other procedures were also followed. An important question here is that of determining what the debitage from other forms of core reduction should look like. At face value, there is no reason to assume that flakes with cortex platforms and little or no dorsal

cortex cover have more to do with bifacial reduction than with the removal of cross-sectional flakes from ovoid or circular cobbles. Again, I think proportions derived from experimentation on cobbles may provide clues to this difficult but important question.

Apart from cortex, there was some size evidence that the reduction process may have been truncated in the exit gate area. These smaller size ranges for flakes may be absent in real terms, absent because of screen size (partly, but not wholly true), or absent in that they are actually present in shatter from the site. This latter possibility will be investigated. I feel the ramifications of recovering less than an entire deduction sequence are important. *Ceteris paribus*, one is inclined to expect the full range of reduction activities at FjPi-29 *if* a variety of tasks were carried out in that vicinity. If blanks and tool preforms were being procured for more distant as yet unresolved future uses, the complete reduction sequence would not necessarily be expected. These issues have considerable bearing on the relationship of this site with others, and hence on regional economic activities.

VI. THE ROLE OF FjPi-29 IN PREHISTORIC SUBSISTENCE SETTLEMENT SYSTEMS

Faunal Remains

The information from faunal remains has a bearing on matters which go beyond the site itself. The simple presence of faunal remains, along with fire broked rock, does tend to imply that FjPi-29 was actually inhabited while raw stone materials were acquired and tools were manufactured. Thus, at least small groups of people seem to have maintained themselves at the site for periods of duration longer than a brief visit. In this regard, a question foremost in my mind is "To what extent did acquisition of the raw material at hand - stone for tools - have reference to other economic activities?" The possibilities range from co-incidental or unpredictable usage of the quarry, to a strategic intersection of quarry activities with other important aspects of the subsistence settlement system.

In a brief report on Pollock's 1978 excavation, Praeger (n.d.: 107:119) identified Bison, moose (Alces alces), elk (Cervus elephas), deer (Cervidae), porcupine (Erethizon dersatum), white-fronted goose (Anser albinfrons), and pintail duck (Anas acuta) remains. This faunal sample, which consisted of 1.9 kilograms of bone, was in a highly fragmented condition. Large mammal bones, especially bison, predominated. There was no definite evidence of butchering, and it seemed that natural rather than human agency had prevailed in the high degree of bone fragmentation. Praeger suggested that the low overall bone to artifact ratio coupled with the limited diversity of animal remains might be taken to indicate that the site was not used for long-term habitation. Although it was not possible to rule out site utilization at other times of the year, the combined presence of goose, duck, moose and elk remains tended most to suggest late fall occupation. The subsequent discovery that FjPi-29 was not a single component site has rendered more hazardous attempts to attribute precise seasons of occupation.

A comprehensive analysis of faunal remains recovered to date must await future studies. From the 1979 excavation, T. Schowalter (personal communication) has been able to identify Bison, large cervid (moose or elk), possibly bear and other remains. As Praeger had noted for the earlier collection, this sample is also contaminated by demonstrably recent faunal species including domestic cow and chicken. Further evidence exists in the form of sawn bone remains. As well, a marine crustacean claw was recovered. In these cases, we must turn to the recent history of the park, once the scene of landfill operations which could clearly contaminate the archaeological record with more exotic faunal remains. A significant range of bison skeletal elements is present, including: tibia, canon bones, femora, mandibles and teeth, astragali, humeri, radii, phalanges, sacra, a calcaneous, a horn core, a scapula and some cranial fragments. Variable degrees of preservation exist, ranging from the fresh recent specimens to fragmentary and poorly preserved prehistoric bone. The picnic pavillion bicycle path excavations produced more bone than had been collected before. Excavation in Area B is most significant because it produced the hind-quarters of a single bison individual (this based on an admittedly cursory examination), thereby suggesting that butchering activities may have been more prevalent at this locus. There is evidence for a paleopathology affecting one of this individual's limbs. These remains are accompanied by those of the large cervid. Remains in the exit gate area are highly fragmentary when compared with those just discussed. No bone tools were recovered during the 1979 excavations.

Seasonal Occupation at FjPi-29

When a site has been occupied for as lengthy a period of time as the Strathcona Science Park Archaeological Site, that is, for 5,000 years or more, the documentation of seasonal usage becomes perilous, particularly in the absence of stratification. As well, the site has

no doubt witnessed significant environmental changes. This factor, coupled with the very longevity of occupation, greatly enhances the possibility of occupations related to more than one season.

Still, there remain several lines of evidence which may suggest a modality in seasonal usage and which may be relevant to other economic questions in the prehistory of the Edmonton area. As noted above, some faunal evidence (notably geese and duck remains) favour spring through fall occupation, with a suggested emphasis on fall. Then again, the location of the site is conspicuous. Situated well above the North Saskatchewan River Valley, FjPi-29 is thoroughly exposed to predominant westerly and northwesterly winds. It does not strike the author as suitable for winter camping. And indeed, if quarrying were the principal focus of activity at the site, the possibility of winter occupation for that purpose is also questionable. Frozen ground and heavy snow cover could certainly inhibit quarrying, although it has already been noted that cold temperatures might be beneficial to the early stages of cobble reduction (Bucy 1979:23; cf. Newton and Pollock n.d.:33). Less so than site situation, the inability to quarry in winter is a weaker line of reasoning concerning seasonal occupation. Quartzite cobbles could always have been stock-piled during summer or fall for subsequent winter use.

In broader perspective, we can also ask if seasonally restricted economic activities took place in the Edmonton region which might have led to recurring occupation of FjPi-29 at some particular point in a seasonal round. Since bison remains dominate the collection, and since Plains-related diagnostics dominate the projectile point collection, it is not unreasonable to phrase such a question in terms of bison reliant economics.

The Strathcona Science Park Archaeological Site is located within the Parkland ecotone and the seasonal movement of bison populations qualifies as one of the most significant annual subsistence events related to site usage (Figure 24). In recent years, older notions

of bison behaviour have been replaced by a model in which it is recognized that bison made seasonal use of the Parkland zone. Historic records quite clearly document the use of impoundment or surround techniques in the communal hunting of bison beginning in the late fall and extending through the winter (see Arthur 1974; Losey 1977).

There is some question about the exact social significance of these activities. For the Powder River Basin (Wyoming) portion of the Northwestern Plains, Frison was prepared to argue that

> ... communal bison procurement in the fall of the year for winter food storage appears to have been part of a cultural system that existed relatively unchanged for a period of about 4,000 years of post-altithermal time. This type of operation brought about the largest consolidation of people in the yearly round of activities. During the remainder of the year, the society fragmented into single or multi-family groups in order to better exploit the ecosystem (Frison 1971:89).

More recently, the same author made the moderate argument that the situation on the Northwestern Plains was on a gradient somewhere between the intensive storage of surpluses by the Arctic peoples and the lack of storage in those areas where seasonal conditions place essentially no restrictions on economic activities (Frison 1978:364-365).

Walker (1974), in reviewing much the same historical evidence as Losey (1977) and Arthur (1974), reached the conclusion that food storage was not essential along the northern periphery of the Plains because communally arranged impoundments appeared to supply meat throughout the winter months. Quigg (1978) has also argued for communal hunting practices in the winter in southwestern Alberta. In addition, he sees the possibility of small and isolated family groups living in the shelter of winter valleys.

An argument based on range management principles is viable for prehistoric bison herds. Morgan (1980) noted an overall picture of geographic convergence of the bison herds onto the summer range of the Plains, with a corresponding geographic divergence onto winter

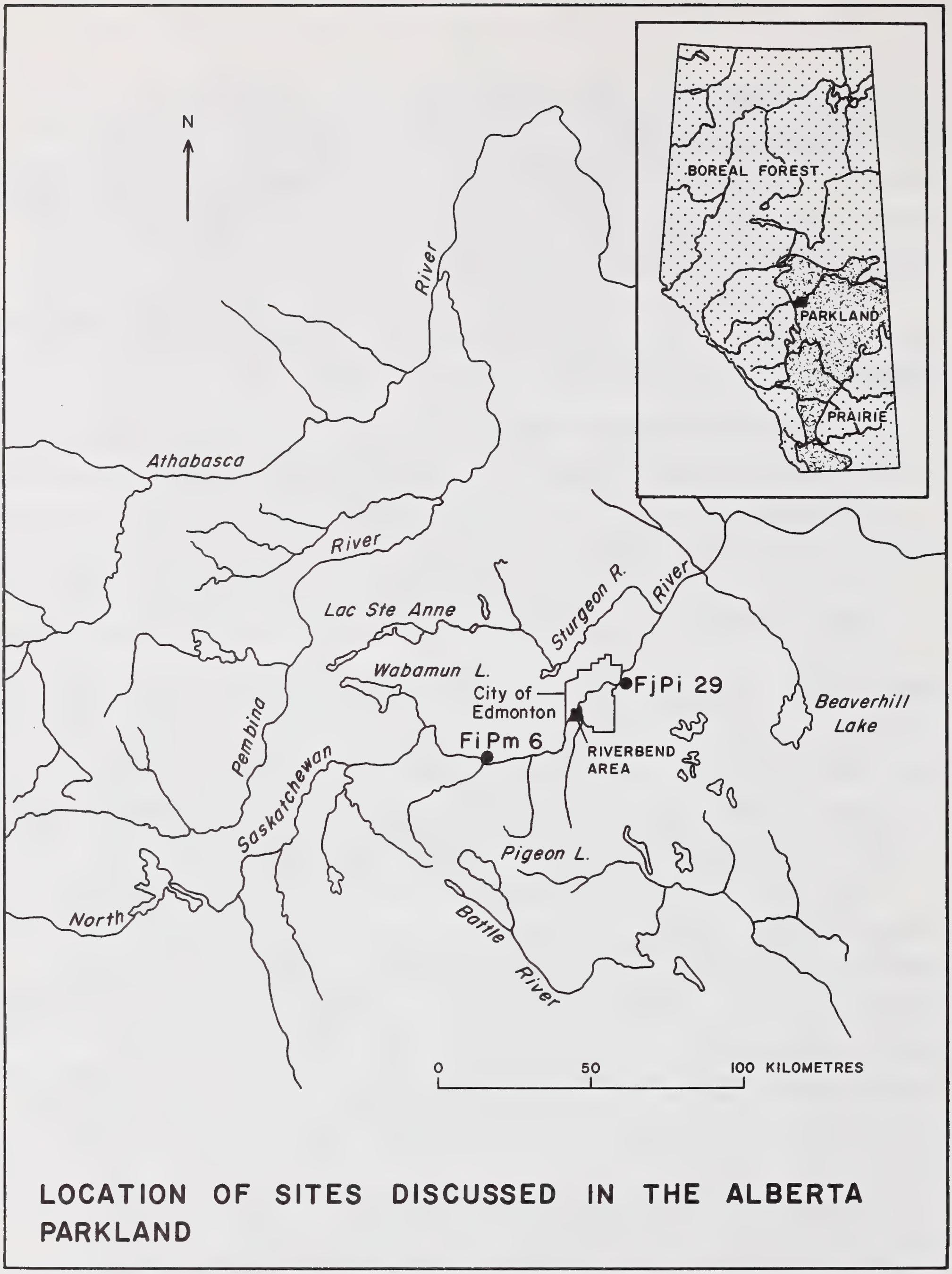


Figure 24: The regional relationship between FiPm-6, the Stoney Plain Quarry Site, FjPi-29, the Strathcona Science Park Archaeological Site and sites located in the Riverbend area of Edmonton. All of these sites are currently located within aspen parkland of Alberta.

ranges such as the Parkland or the Foothills. Movements to the winter range involved a gradual amalgamation of herds into specific localities suited for winter habitation. Movements to the summer range entailed a gradual dispersal of smaller herds. Making analogy to a two-field rotation system, Morgan (1980:156) suggested that these movements resulted in an optimal use of winter and summer grazing ranges. Specifically with reference to the Strathcona Science Park Archaeological Site, it is important to note Hind's (1971:108-109) comment to the effect that the "... great western herds winter between the south and the north branches of the Saskatchewan, south of the Touchwood Hills, and beyond the North Saskatchewan in the valley of the Athabasca".

In spite of the potential for vegetative shifts as a concommitant of environmental change, FjPi-29 has probably been located somewhere within winter bison range for the great majority of prehistory represented at the site. Even if this were not strictly true, differing aspect and moisture conditions created by the North Saskatchewan River Valley would likely have contributed to a viable wintering situation for smaller groups of bison and hence people. Consequently, this scenario has several implications for workshop activities at FjPi-29.

The Strathcona Science Park Archaeological Site could have been used and no doubt at some points in its prehistory was used sporadically by small and perhaps even fairly large social groups during every season of the year. Based on the evidence just reviewed, however, this does not constitute a predictable modal usage of the site. The organization of bison hunting economics would favour most extensive site use from the fall continuing to the spring. The setting of the site and other weaker forms of evidence tend to favour the fall end of this spectrum. That being true, several alternatives suggest themselves:

1. a) Comparatively large, mixed social groups may have camped at the site during the fall or spring essentially to retool for bison hunts of these seasons. The location of these hunts would be presumed to be relatively near to FjPi-29.

b) The material consequences of these activities would involve the production of large numbers of biface blanks, preforms and specific tools to be employed in "close at hand" hunting and butchering locations. An entire lithic reduction sequence is anticipated, accompanied by evidence of residential occupation. We must recall that evidence for residential use may have already been destroyed by use of large portions of the site for landfill.

2. a) Similar groups may have camped close to FjPi-29 during fall, winter or spring but not on the site. Their intentions would have been those of the first example.

b) The archaeological correlates of this pattern would be similar to those listed above, although evidence of residential occupation would be lacking.

3. a) Large, mixed social groups may have camped at or near the site in the fall, preparatory to fall and winter bison hunting at distant locations. This line of reasoning assumes that FjPi-29 would be between summer bison range and winter bison range shifted to the north. I would view this as a short but intensive form of use which was specialized strictly in lithic procurrement.

b) Such a situation would involve the production of large numbers of biface blanks and preforms (to transport lithic materials efficiently), along with possible indications of residential occupation. Fewer specialized tools would be anticipated, since intended use would not be immediate.

4. a) Small, specialized task groups, presumably male, may have visited the site from relatively distant residential camps somewhere in the Edmonton area. Their intention would also be the specialized procurement of lithic material, although such visits might have been carried out in conjunction with other specialized tasks.

b) The material consequences of this activity might also be to produce large amounts of lithic material in easily transportable form. Slight evidence of quasi-residential occupation -- such as overnight stays -- would be possible.

5. a) Finally, the site may have seen sporadic fall and winter use by small family groups. They would be hunting on winter bison range, but might also have taken advantage of the greater shelter and resource diversity present in the river valley. Such groups could have camped at the site and in the general area.

   b) Evidence of residential occupation may or may not be available. Aquisition of lithic resources and tool manufacture would likely be less intensive. Since intended tool uses might be forseen, greater numbers of more specialized tools might be produced in these instances.

To connect these constructs with the comparatively small and heterogeneous body of information from FjPi-29 can only be attempted in the most tentative manner. I do suggest that it is in this realm that the most meaningful questions concerning site history and function may be asked. Although immense problems of disturbance and stratigraphy exist, FjPi-29 can still be examined for pertinent evidence of size and composition of groups present at the site by means of the spatial structure and diversity of artifact classes distributed across the remaining portion of the site. To return to the question raised at the beginning of this section, perhaps the greatest wealth of information in that portion of the site which remains, resides in stone tools, waste flakes and shatter left from quarrying and workshop activities at the front of the terrace.

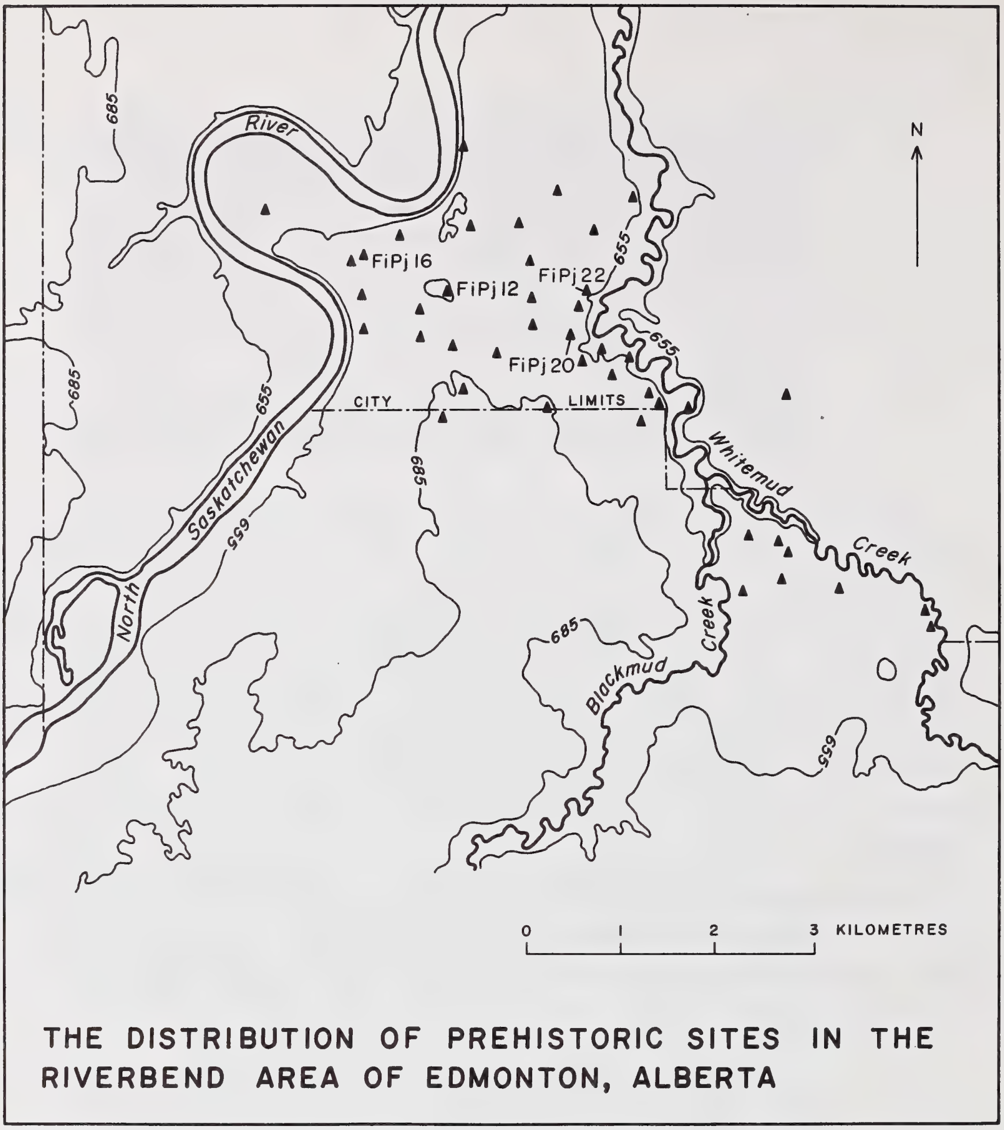


Figure 25: The distribution of prehistoric sites in the Riverbend area of Edmonton, Alberta. Included are FiPj-12 (Prosser Site), FiPj-16, FiPj-20 and FiPj-22.

VII. FjPi-29 IN REGIONAL PERSPECTIVE

Borden Block Summary

Four Borden blocks neatly encompass the present Edmonton area. These are FiPi, FiPj, FjPi and FjPj. To gain an impression of prehistoric land use in the Edmonton region, site types from Archaeological Survey of Alberta site forms were tabulated. It must be clearly borne in mind that individual investigators have made highly variable site type designations. As well, a variety of site type names are in use. Different investigators also apply different names to the very same numbers and ranges of materials in different categories. As of November, 1980, 208 sites were on file for the four Borden blocks listed above. Just under 30% of these sites are historic and the great majority of these fall in FjPi. These sites are largely related to turn-of-the-century coal mining in the Strathcona area. Just less than 20% of the remaining sites can be classed as isolated finds - that is, consisting of one or two artifacts only. The best represented category is that of campsites (buried or surface). Slightly less than 40% of the recorded sites have been classed in this way. It is vital to note that a number of these might otherwise be regarded as isolated finds or small loci for special activities at which a few lithic artifacts have been discarded. In defence of this figure, a fair proportion of these sites had relatively dense lithic scatter, fire broken rock and fragmented bone. One (FjPi-75) is a tipi ring. Campsites are most numerous in blocks FiPj and FjPi. The remainder of the sites involve tentative kill sites, various surface scatters and paleontological finds.

Diagnostic items for recorded sites are rather rare. They do encompass the same time period dealt with at the Strathcona site, and Oxbow, McKean, Pelican Lake, Besant and Late Prehistoric point types are each represented. The implications of this brief summation

are not great as the information does not bear precise comparisons. There do appear to be a number of small camps and small activity foci in the Edmonton area. There are some potentially larger campsites, although these would not be inordinately large. Kill sites are sparse, and there are no documented instances of large scale drives or surrounds. Riverbend and Capital City Recreation Park studies in the Edmonton area should be noted. The historical resources impact study conducted by Aresco Ltd. of the Capital City Recreation Park Complex did serve to show a relatively high density of prehistoric activity in the immediate vicinity of FjPi-29. Survey of Goldbar Ravine, Hermitage and Rundle Parks yielded 22 prehistoric sites (Aresco Ltd. 1976). These were mainly small campsites and isolated finds. A campsite/kill is noted as are two other possible kills.

The comparatively intensive work carried out in association with the development of the Riverbend neighbourhoods does provide better grounds for comparison with FjPi-29 (Figure 5). In recent years, this area, found between the North Saskatchewan River and Whitemud Creek southwest of Edmonton, has been the scene of several historical resource impact assessments. These have produced a comparatively high density of prehistoric sites, totalling 31 in number. From these sites, it appears that the Riverbend area was occupied during Middle and Late Prehistoric times as well. The majority of these are isolated finds, or rather small clusters of artifacts indicative either of brief and small camps of specialized activities (small kills, butchering, etc.). Four sites merited further work, and FiPj-12, FiPj-16, FiPj-20 and FiPj-22 were the subject of mitigative investigation in the form of controlled surface pick-up and/or excavation (Whelan and Heitzmann 1980). All four had been badly disturbed by agriculture. Heitzmann, in his work upon these sites, operated under the premise that

> The Riverbend area served in the past as a natural funnel which concentrated bison towards the point of the funnel. The single hill in the area under study, FiPj-12, was a hunting base and stand which was used to observe animal move-

> ments. A number of other sites scattered throughout the Riverbend area are killing and butchering stations which include sites FiPj-16, 20 and 22 ... Sites FiPj-16, 20 and 22 are representative of a large number of kill and processing sites that are scattered along the upper banks of the valleys. These localities were favoured because the varying topography had advantages of offering cover to small hunting groups (Wehlan and Heitzmann 1980:19).

FiPj-12, the Prosser Site, received the most extensive treatment. Oxbow, McKean and Late Plains projectiles were recovered (Heitzmann and Priegert 1980). A total of 1,721 artifacts were catalogued, including bipolar cores, multiplatform cores, cobble spalls, edge modified flakes, debitage, unifaces, bifaces, projectile points and choppers. Fire broken rock and small bone debris were reported. With respect to the passage quoted above, Heitzmann reached the conclusion that the site usually functioned as a chipping station and as a lookout. I find it difficult to rule out the possibility that it did not also function as a base camp at various times.

The collection from the Prosser Site is the largest of the four; the information presented on debitage is of some interest. In the case of finished tools, we must recall that this site has been subjected to severe collection pressure. The broad categories of raw material are similar in their proportions to FjPi-29. Quartzite is 70.3%, petrified wood is 17.0%, chert is 5.1%, mudstone is 2.3% and "other" (chalcedony, quartz, jasper) is 5.3%. Note, however, that the percentage of quartzite is significantly lower, while petrified wood is distinctly higher than is the case for FjPi-29. Heitzmann found that decortification flakes slightly outnumber secondary decortification flakes (defined by Figure 12, Heitzmann and Priegert 1980:37). This is somewhat unusual, but could be explained by minor local procurement of cobbles for reduction. Likewise, alternative means of reduction might contribute to this result. By my calculations, the ratio of tertiary flakes to primary and secondary decortification flakes is close to 6 to 1. Given that the categories I employed

earlier (cortex versus non-cortex) could be compared with this breakdown, this is a rather significant difference with the Strathcona Science Park Archaeological Site.

FiPj-16, FiPj-20 and FiPj-22 are all somewhat smaller and less productive sites. FiPj-16 has produced Oxbow and Besant projectile points. Whelan and Heitzmann (1980:21) concluded that this site functioned as a workshop for tool blanks and preforms, activities possibly associated with the processing of large game. FiPj-20 was involved in the production of finished tools and possibly was used for limited meat processing. Finally, FiPj-22 produced too few artifacts for comment. Heitzmann's conclusion for FiPj-16 is based upon the high percentage of decortification flakes. These occur in a 2:1 ratio over reduction and retouch flakes (non-cortex flakes). It would thus seem that whole cobbles were being brought to FiPj-16 for reduction. One would presume that large distances of transport would not be involved and that some nearby source would be sought. This is not necessarily so, though far more likely. At FiPj-10, debitage would appear to indicate that the final phases of tool manufacture as well as tool maintenance took place.

The Relationship Between FjPi-29 and Other Parkland Sites

Documenting the relationship between sites such as these and FjPi-29 would be hazardous at best. The extensive disturbance and lack of stratigraphy affecting all of these sites accentuates this problem. Given this caveat, and given that most of the sites in this area have evidence for the later stages of tool formation, it is not unreasonable to propose that FjPi-29 had some relationship to sites in the Riverbend area. In spite of the conclusion for one site, FiPj-16, later phases of manufacture seem to dominate the lithic debitage at Riverbend. A regional implication of this might well be that a considerable quantity of the raw material used for tools in this location originated to the

northeast at the Strathcona Science Park Archaeological Site. In that sense, the ultimate destination of many biface blanks and preforms might have been Riverbend. These tools' purpose, as Whelan and Heitzmann have suggested, might very well have been for bison hunting predicated upon the unique, but favourable geographic circumstances of this area. That is not to say that other destinations were not involved, or ever favoured. In fact, the Riverbend area is not that far removed from the Stoney Plain Quarry (Losey 1971). The Stoney Plain Quarry, also located on the North Saskatchewan River, resembles FjPi-29. It may have been a significant or even exclusive supplier for the Riverbend area. This raises an issue touched upon earlier. Before we can understand the structure of man-land relationships in the greater Edmonton area -- insofar as these can be related to the use and procurement of raw stone materials -- this issue must be resolved. Could suitable raw materials (largely quartzite cobbles) be quarried almost continuously along exposures of Saskatchewan Sands and Gravels created by the North Saskatchewan River? Or do discrete areas particularly favourable to quarrying exist?

It is my impression that we have not missed that many workshops and quarries the size of Stoney Plain and FjPi-29. If this is valid, the specificity of these locations may mean one of two entirely different things. There may simply be qualitatively and quantitatively superior quarries found only at certain locations such as the Strathcona Science Park Archaeological Site. Or, the case may have been that quarrying locations and activities were largely expedient, and had much greater reference to other socio-economic activities. Perhaps there were particularly economically attractive aspects of the Stoney Plain Quarry and Strathcona Science Park areas unrelated to the quality of quarry sources. The flow of prehistoric lithic resources through the Edmonton region was likely contingent upon these factors. Thus, issues related to quarries and workshops can be seen to touch upon broader questions of prehistoric economy and social organization.

In effect, we may ask of the prehistory of the Edmonton area whether or not we are dealing with _embedded_ or _direct_ procurement strategies (Binford 1979:259). In an embedded technology, only rarely do individuals or groups "go out into the environment for the express and exclusive purpose of obtaining raw materials for tools" (_ibid_.). The procurement of these raw materials takes place within the context of other economic activities. The opposite situation would of course be true of direct procurement strategies. Binford finds embedded procurement strategies and wideranging "caching" to be two major characteristics of hunter-gatherers who are organized logistically. In _logistically organized_ societies, parties organized specifically for procurement of certain target resources move out of residential locations to temporary camps for their own maintenance. While exploiting the resources of a specific location, they also range out of these camps to execute other procurement strategies. Alternately, with _foraging_ societies, persons range out into the environment to search for resources and return to a residential location each night (_ibid_.:270). While issue might be taken with a number of points here, Binford has made an important recognition concerning material and archaeological expressions of economics organized upon different cultural logics. An appreciation of the degree to which lithic resources were directly or indirectly procured at FjPi-29 would inform us of important aspects of pre-equestrian economics in the Plains and Parkland regions.

VIII. CONCLUDING REMARKS

Now known to have been visited over at least the last 4,000 years, artifacts from the Strathcona Science Park Archaeological Site indicate Oxbow, McKean Complex, Pelican Lake, Besant and even more recent Late Prehistoric occupations.

Perhaps further research can answer the question of whether or not the most common forms, McKean and Besant styles, are also indicative of the most intensive periods of utilization. On environmental grounds, it is suspected that the site served as a lithic workshop to people exploiting or preparing to exploit bison over-wintering in the parkland ecotone.

It is difficult to bring to bear the details of the archaeological record recovered upon this larger realm of issues, although several tentative steps have been made here. The large scale excavations in the gate area, when subjected to spatial analysis, did provide some promising results once the complexities created by disturbance had been sorted through. It is quite likely that less disturbed areas of the site can produce more clearly percieved large and small scale patterning in the distribution of artifacts.

Regardless of the results of this application, various techniques of spatial analysis have important potential applications at FjPi-29. Be it trend surface analysis, spectral analysis, order neighbour analysis, unconstrained clustering or recent elaborations of Greig-Smith's mean square block analysis, the results of this work would contribute greatly to an understanding of different activity areas at the site. The exit gate area was severely disturbed and few other locations have suffered the same degree of damage. I would caution that the comparatively high density of artifacts may cloud efforts to "horizontally disentangle" artifact distributions. Still, the results of spatial analysis when combined with tool and core refitting studies could prove a powerful tool for circumventing the lack of stratigraphic control at the site.

The other medium by which we can understand the articulation of FjPi-29 with aspects of a regional subsistence-settlement system is that of stone tools. Although complicated by the effect of screen mesh size and comparatively superficial analysis of shatter, the evidence of size classes and the total representation of cortex bearing classes may suggest that full biface reduction was not taking place in the exit gate area. One must question to what extent this may reflect upon events typical of the entire site. Flakes covered largely by cortex, or primary decortification flakes, may be under-represented at the site. If detailed analysis of shatter confirms this, it is possible that satellite extractive camps existed nearby in the river valley.

There is an additional means by which we may infer intersite relationships between FjPi-29 and other locations. To my mind, there is a low diversity of non-debitage tool types at the site. Whether or not specimens such as used edge modified flakes imply significant domestic occupation or merely the presence of non-lithic tool manufacturing activities, there simply do not seem to be very many kinds of artifacts in the collection. To account for this state of affairs, several thoughts should be set forward. I would predict that if tool manufacture at FjPi-29 were principally aimed at creating tools for tasks which were to be carried out relatively close to the site, then a detectable diversity of tool types and resultant debitage should be present. This would be true because discards, rejects and the expedient nature of debitage should all reflect greater specialization of tools in spite of the fact that most tools would be taken away. The greater specialization of tools is predictable because more immediate uses would be foreseen. Alternatively, if tool manufacture was undertaken to build up an inventory of raw materials for activities more distant in time and space, one might expect a limited diversity of tools and the debitage from tool manufacture. This would be true in that blanks and preforms would be the almost exclusive end product. These forms would allow for efficient transport of raw material while leaving

open the ultimate functional form created. That is, specific tasks in which tools were to be used might not be as clearly foreseen. The latter alternative may be most true of FjPi-29 materials uncovered to date.

Reasoning along these lines leads again to questions of regional scope, although this avenue is the inverse of the argument made earlier. Whatever the case, there are several ways of approaching the interrelationships between FjPi-29 and other sites in the region. The site is not simply a repository for detailed technological information, but can also tell us something of the flow of lithic resources throughout the region. That, in turn, informs us of another order of socio-economic questions. I cannot overstress the value of such issues for long-term research and the next phase of interpretation.

There are several facets of the future treatment of the site which should be recognized now. With some 25,000 artifacts already on hand, there is no question but that any type of concerted excavation effort will yield a monumental collection. The specimens will require proper housing and it will be by far best for future workers if they are housed together. More critically, the information that can be garnered from each item could only be handled in some convenient format. I must stress that uniform cataloguing procedures and standardized recording of information from each artifact are now essential. Already, the only feasible means of dealing with this collection is through a data retrieval system, preferably with an on-line terminal which could be easily accessed. The facilities provided by the building at the site allow one of the best opportunities possible for this approach, now so common on large projects with similar amounts of information to handle.

Personally, I have grave doubts if any form of cultural stratigraphy could be demonstrated for the site. If it ever did exist, subsequent disturbances have truly had a sweeping effect. This does not mean that new approaches to the problems of small scale stratigraphy should be discouraged at the site. Indeed, it is the ideal testing

ground for this difficult problem. By the same token, widespread disturbance and lack of stratigraphy do point clearly in one direction. When a site has a specific function, as does this one, and when that same site has a combined archaeological record extending over thousands of years of prehistory, one of the few profitable avenues by which to proceed would be to accept the constancy of site function as a working premise. At the most general level, if there is a certain homogeneity of results, then one might expect that the site contributed to a region's prehistory in much the same way through time. This would be a significant finding to demonstrate conclusively. If the premise were untrue, then more heterogenous results may very well follow. The nature of the archaeological record at the Strathcona Science Park Archaeological Site pushes us in the direction of that working premise. At the present time, perhaps only 10% of the site's original extent remains for excavation. In effect, our excavations are sampling a rather small sample. That being true, to speak of trends in heterogeneity or homogeneity in the artifact assemblages and their spatial organization absolutely requires that we be confident that we have representative information from the site. Rather than making conclusions about excavations in the exit gate area and so forth, I feel a well planned sampling strategy should be implemented to provide a stable underpinning for generalizations about the site.

With these applications, the Strathcona Science Park Archaeological Site would be able to fulfill its role in the extensive interpretive program developed about it, while at the same time it could make possible meaningful research contributions.

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FIGURE 26: The Archaeological Centre at the Strathcona Science Park under construction in the winter of 1980.

FIGURE 27: Construction activities viewed from the exit gate area during the winter of 1979.

FIGURE 28: Excavations in the exit gate area. The posts are for a chain link fence surrounding the site.

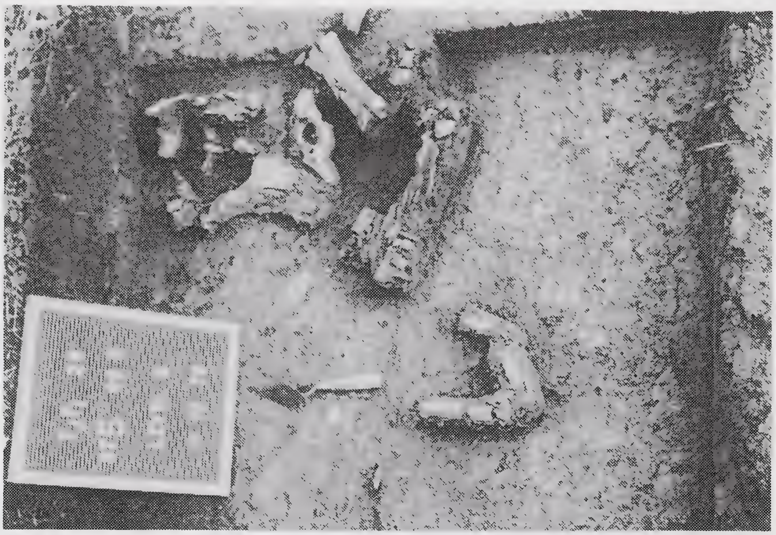

FIGURE 29: Faunal remains uncovered in Unit B of the Picnic Pavillion Bicycle Path area.

FIGURE 30: Ceramic neck sherd showing exterior cord-marked impressions.

FIGURE 31: Endscrapers recovered during Newton and Pollock's work in the spring of 1979.

FIGURE 32: Split pebbles recovered during Newton and Pollock's work in the spring of 1979.

FIGURE 33: Three forms of biface from FjPi-29. The specimen on the right comes from Newton and Pollock's work during the spring of 1979. Note the pronounced asymmetry and extremely fine lateral retouch of the specimen in the centre. This item, which was discovered on the fall of 1979, appears to be a finished tool.

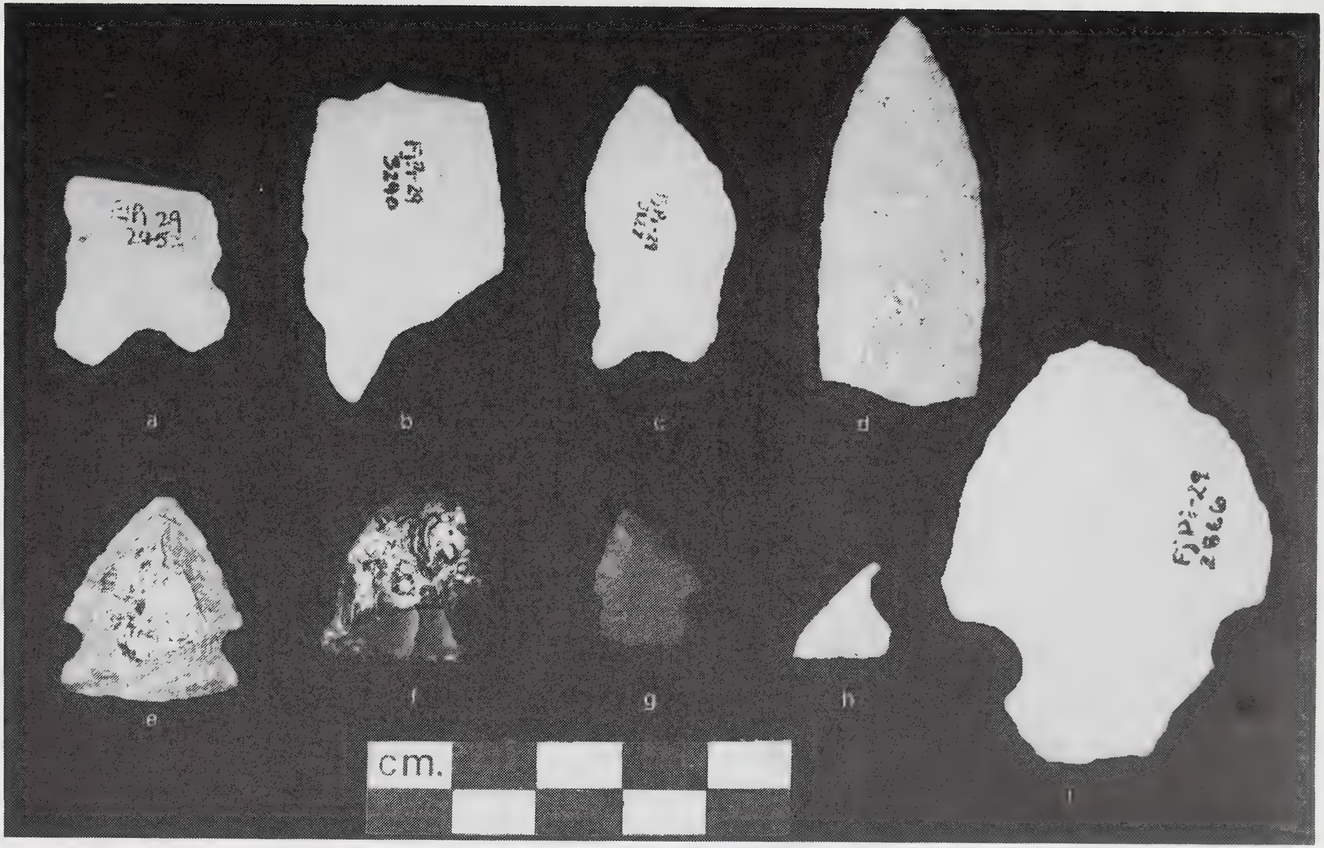

FIGURE 34: Small bifaces recovered by Newton and Pollock in their 1978 and 1979 excavations.

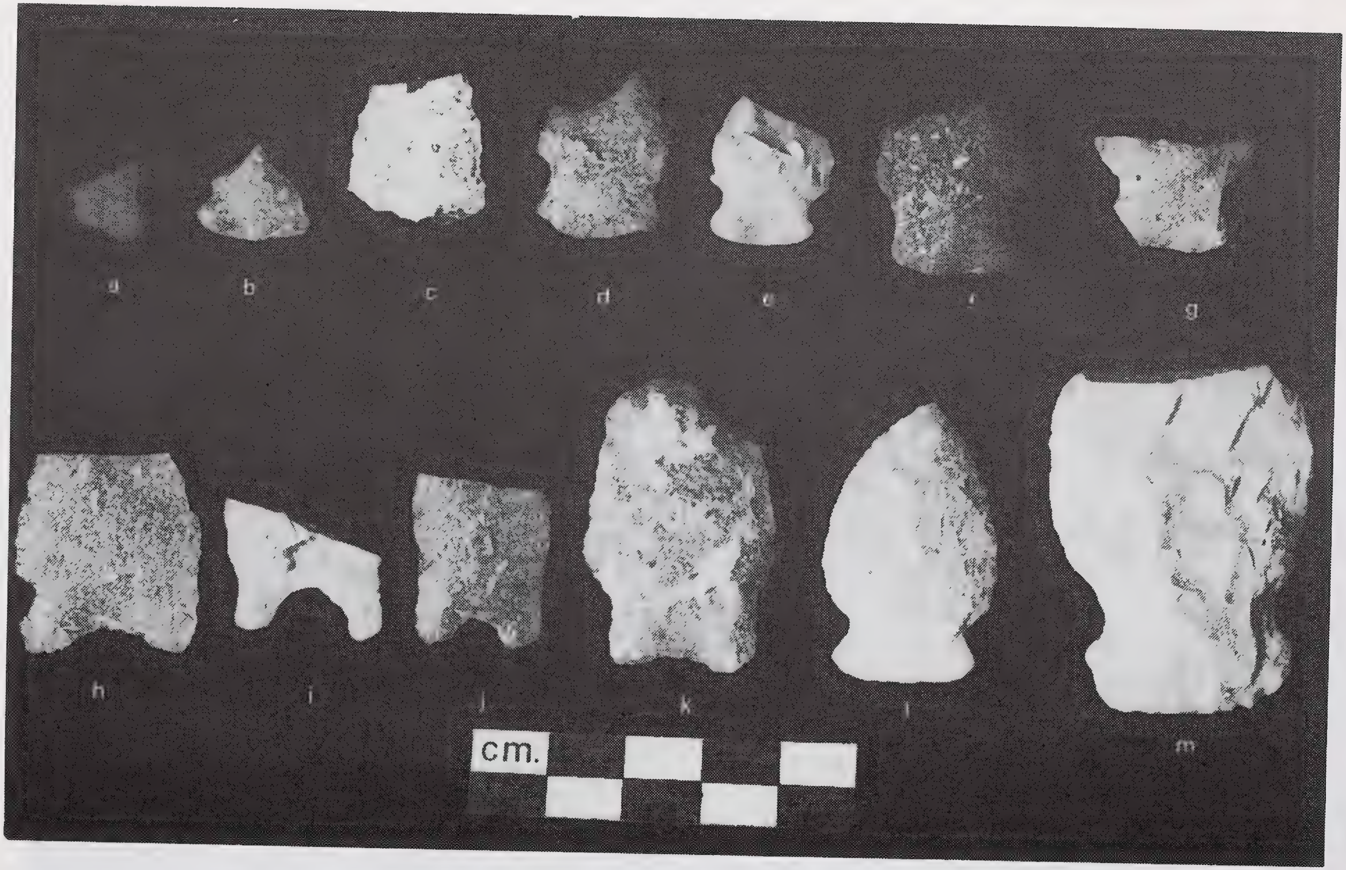

FIGURE 35: Small bifaces recovered during the impact mitigation undertaken in the fall of 1979 by Ives.

FIGURE 36: Large, discoidal bifaces which appear to be in the early phases of reduction.

FIGURE 37: Large bifaces from fall, 1979 excavations. The specimen to the right appears to have broken during manufacture while the biface on the left shows distinct asymmetry and fine lateral edge retouch.

FIGURE 38: A large biface which appears to have been used as an adze. Note the intense battering and step fracturing toward the right hand edge of the specimen.

FIGURE 39: Endscrapers recovered from the exit gate excavations in the fall of 1979.

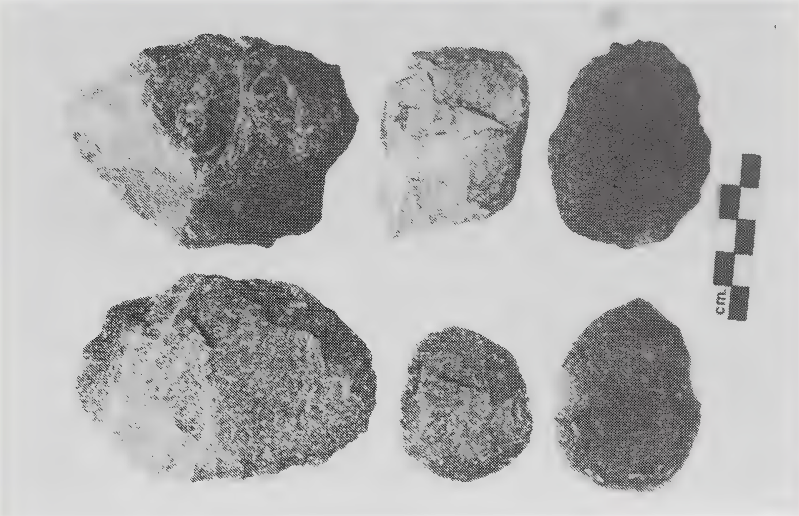

FIGURE 40: Large unifaces excavated in the exit gate area during the fall of 1979.

FIGURE 41: Large cores from excavations during the fall of 1979.

FIGURE 42: Discoidally shaped cores discovered in the fall of 1979.

FIGURE 43: A sample of split pebbles from FjPi-29.

FIGURE 44: Pitting on the working surfaces of hammerstones recovered from the exit gate excavations of 1979.

FIGURE 45: A large anvil from the fall, 1979 excavation.

FIGURE 46: Another example of an anvil from excavations in the exit gate area.

FIGURE 47: A large specimen of quartzite, with a bifacially shaped notch shown at the top of this plate. A similar item, shaped like a figure eight, has been noted in the Sheptycki collection. These specimens may have been used as mauls or as implements to aid in the recovery of quartzite cobbles during quarrying. The notching is presumably related to hafting.

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2. FjPi-29, A Prehistoric Workshop Site in the Alberta Parklands. By B. Newton and J.W. Pollock. 119 pp. 1985 (Bound with No. 3 and No. 4).

3. Archaeological Exavation at the Strathcona Science Park Site (FjPi-29). By H. Pyszczyk. 222 pp. 1985 (Bound with No. 2 and No.4).

4. The Results of Mitigative Excavations During the Fall of 1979, Strathcona Science Park Archaeological Site (FjPi-29). By J.W. Ives. 108 pp. 1985 (Bound with No. 2 and No. 3).

5. A Spatial Analysis of Artifact Distribution on a Boreal Forest Archaeological Site. By J.W. Ives. 167 pp. 1985.

6. The Archaeology of Victoria Post, 1864-1897. By M.R.A. Forsman. 225 pp. 1985.

7. Hawkwood Site (EgPm-179): A Multi-component Prehistoric Campsite on Nose Hill. By S. Van Dyke and S. Stewart. 224 pp. 1985.

ARCHAEOLOGICAL INVESTIGATIONS AT THE STRATHCONA SCIENCE PARK SITE (FjPi-29)

FINAL REPORT

PERMIT NUMBER 80-74

by

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Submitted to

Alberta Culture
Historical Resources Division
Archaeological Survey of Alberta
Edmonton, Alberta

January 1981

PREFACE

When Gabriella Prager and I conducted excavations at the Strathcona Site in 1980, we recovered thousands of waste flakes and detritus, spanning a 3,700 year period, all compressed into 30 cm - 40 cm of matrix -- and very little else. It was not too difficult to see what direction our research might take. In fact, we were left with little choice except to examine lithic reduction techniques and to determine whether, in spite of the compressed stratigraphy (if one could call it stratigraphy), it was possible to recognize any temporal changes in these reduction techniques. Although the contents of this report also describe the results of other field objectives (i.e., site size/boundaries) which we felt were important to understand at the early stage of site investigations, examination of those two themes were essentially the major aims of this report in 1980; they are as important today as they were then.

Subsequent investigators at the Strathcona Site disagreed with some of the results in this report; others supported many of its findings. Professional disagreement stimulates more research, but this cannot take place unless other archaeologists also are aware of this disagreement. The only way to increase such awareness is to make more of these manuscripts available to a larger professional audience. This support of publication of archaeological reports will undoubtedly be beneficial to Alberta archaeology and arouse interest in research on problems such as those dealt with in this report.

The challenge of trying to apply micro-stratigraphy and knowledge of reduction techniques to site interpretation is only just beginning. A better understanding of these issues is critical if questions about culture change are to be answered. I hope that some of the results of this report will provoke more thought and research into these areas of archaeological inquiry. Judging from the Strathcona Site reports that followed this one, it appears that my hopes will be fulfilled.

Heinz Pyszczyk
The Archaeological Survey of Alberta
Edmonton, 1985

ABSTRACT

Investigations of a north-central Alberta prehistoric quarry/workshop were conducted throughout the summer months of 1980. Research objectives were of a practical and academic nature, as well as publicly oriented since the site had recently been developed into an archaeological interpretive center where the public could view archaeological research in progress.

Investigations included completion of unfinished fieldwork, and incorporation of a topographic map by a N.A.I.T. survey team. A systematic area survey more objectively defined site boundaries. Results from a proton magnetometer survey were assessed, and greater vertical control of site stratigraphy was attempted by using three dimensional mapping methods; results from both analyses were disappointing.

Lithic remains yielded two additional projectile point types--Avonlea and Pelican Lake. The lithic analysis was primarily aimed at thoroughly examining debitage. A series of flake types were described enabling future researchers to more explicitly identify prehistoric lithic reduction techniques. Temporal site debitage comparisons suggest that little change in lithic reduction techniques or raw material utilization occurred. Comparisons to other regional lithic assemblages shows a considerable arithmetic range which presumably reflects numerous human activities; such comparisons have helped isolate those variables that distinguish lithic workshops/quarries from other prehistoric sites.

ACKNOWLEDGEMENTS

I wish to express my thanks to my field assistant, Gabriella Prager, and field crew, Lan Chan, Heather Dumka, and Guy Trott who so diligently excavated and processed artifacts throughout the summer. Their patience with me, their surroundings, and with the public is greatly appreciated.

My thanks to the research staff at the Archaeological Survey of Alberta who always assisted as best they could under various, and sometimes difficult circumstances.

Gabriella Prager typed the manuscript and also offered help with editorial changes. Responsibility for any errors or omissions, however, must rest with me.

Heinz Pyszczyk
Project Director
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INTRODUCTION

Archaeological investigations were conducted at the Strathcona Site from June 15 through September 6, 1980 under the direction of the author, assisted by Gabriella Prager, with a field crew composed of Lan Chan, Guy Trott, and Heather Dumka. Research was made possible with a contract and funding awarded by the Archaeological Survey of Alberta, Alberta Culture.

RATIONALE

The geographical setting and nature of the Strathcona Site make it an invaluable public educational center and academically informative site (Figure 1). The surrounding area has been developed into a science park housing a variety of scientific displays. With this theme in mind, Alberta Culture developed this prehistoric workshop into an archaeological interpretive center since it was conveniently located within park boundaries. The public were invited to watch our field crew excavate, record, and analyse all recovered prehistoric remains. As well, a newly constructed research laboratory/museum facility housed displays on North American culture history, tool manufacturing methods, and archaeological laboratory techniques. Thus, continuing investigations at the Strathcona Site produced a more informal educational setting for the public to learn about Alberta's cultural resources.

The Strathcona Site is one of the few parkland lithic quarry/workshops to have been thoroughly investigated. In the future, data from the site will help archaeologists more thoroughly understand raw material attribute selection. As well, research was also directed toward understanding specific lithic reduction techniques and should help establish a lithic reduction attribute list which will aid in more clearly defining aboriginal technological methods. Moreover, in the future data from this site should add to a regional synthesis of aboriginal resource utilization and settlement patterns. Finally, the site was also used to assess some relatively new, potential archaeological research techniques and their effectiveness in recovering cultural remains.

To summarize, excavations were directed toward more informally

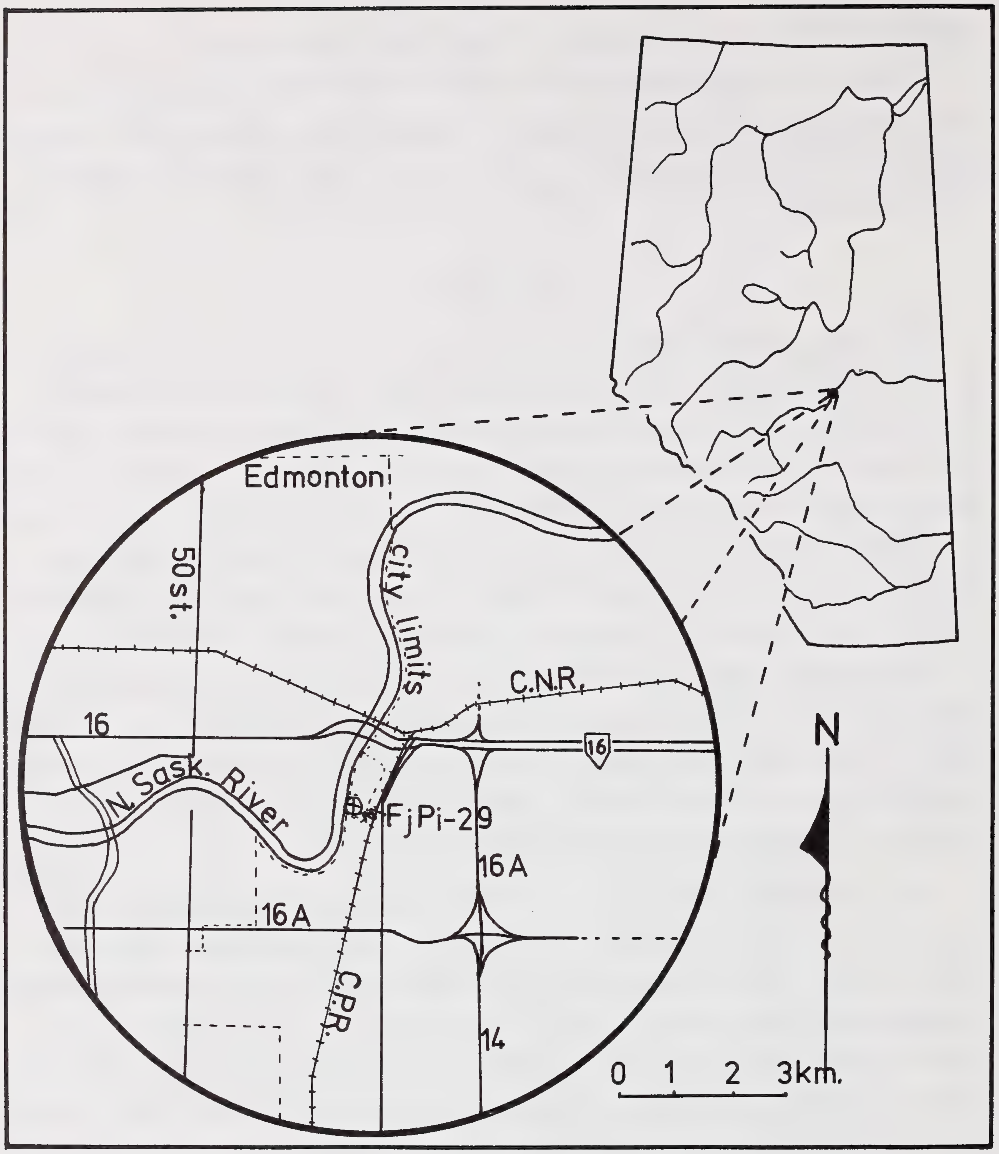


Figure 1. Location of the Strathcona Science Park Site (FjPi-29).

educating the public on archaeological research methods and Alberta prehistory. Additionally, specific lithic technological problems were investigated and will help place the Strathcona Site into a regional framework in terms of resource utilization and aboriginal settlement patterns.

REGIONAL SETTING

ENVIRONMENT

The Strathcona Site is located in the prairie-forest ecotone where continental climatic conditions consist of short, hot summers with +15^{o}C mean July temperatures, and long, cold winters with -17^{o}C mean January temperatures (Hardy 1975).

Vegetation in the aspen parkland transition zone consists of dense aspen stands interspersed with meadows (Rowe 1972:35). Trembling aspen is the predominant tree species, although some birch as well as other conifers such as pine, spruce, and tamarack are found in the river valleys, along lake shores, and sandy glacial outwash areas. Of major importance are the numerous berry-producing species (raspberries, pincherries, chokecherries, saskatoons and blueberries) which grow along river terraces and also in sandy, well drained areas.

The parkland's topographical and vegetational diversity make it a highly productive wildlife habitat. Abundant lakes, sloughs, and rivers are the nesting grounds of a large variety of waterfowl and abound with numerous fish species. Such habitat is also important for large mammals and many smaller mammals such as beaver, muskrat, mink, otter, lynx and hare. Perhaps most important however, the parkland served as the wintering grounds for the plains bison which was an important source of food for past aboriginal peoples.

CULTURE HISTORY

A summary of the regional culture history comes from Wormington and Forbis (1965), Reeves (1970), Adams (1976), Pollock (1978), and Losey (1978).

Evidence for prehistoric peoples in Alberta's prairie-forest ecotone has been traced back to the Early Prehistoric Period (ca. 10,000 B.C. - 5000 B.C.). The early part of this period is represented by Clovis and

Folsom fluted points which are documented further south by a few surface finds. The first well documented finds are represented by later Scottsbluff, Eden, and Cody Phases (Wormington and Forbis 1965). Peoples from these phases were free-ranging hunter/gatherers who relied heavily on a large game animal subsistence economy, but also utilized a variety of other game animals, waterfowl, fish and plant species.

All the Early Middle Prehistoric Phases (ca. 5500 B.C. - 1000 B.C.) are well documented in the region and include Oxbow, McKean, Duncan and Hanna points. Often these phases, such as the Oxbow Phase, occur over a long temporal and geographical span. Technological innovations include the introduction of atlatls and bison pounds. The Late Prehistoric Period (ca. 1000 B.C. - A.D. 200-700) is represented by a plains-oriented Pelican Lake Phase (Tuxana Tradition), while the Besant Phase, or Napikwan Tradition, is more woodlands-based (Reeves 1970). Bison pounding becomes more predominant and tipis are introduced at this time.

The Late Prehistoric Period (ca. A.D. 200-700 - A.D. 1770) is characterized by corner and side-notched projectile points, cord-marked pottery, use of the bow and arrow, and large game driving activities. The Tuxana Tradition is represented by the Avonlea Phase as well as later side-notched point types.

Historically, Athabaskan-speaking (Beaver, Sekani, Sarsi) and Algonkin-speaking groups (Blackfoot, Assiniboine, and Cree) exploited regional resources (Losey 1978:56). Tensions between these groups over local resources often occurred although they were certainly increased by European economic intervention (Ray 1974). Whether similar inter-group disparities existed prehistorically over local resources is presently poorly understood (Losey 1978).

SITE DESCRIPTION AND HISTORY

ENVIRONMENT AND GEOLOGY

The Strathcona Site is located on the upper-most terrace, immediately east of the North Saskatchewan River at an elevation of 660 meters above sea level and approximately 60 vertical meters above the North Saskatchewan River (Figure 2). Westgate (1969:138) has identified four

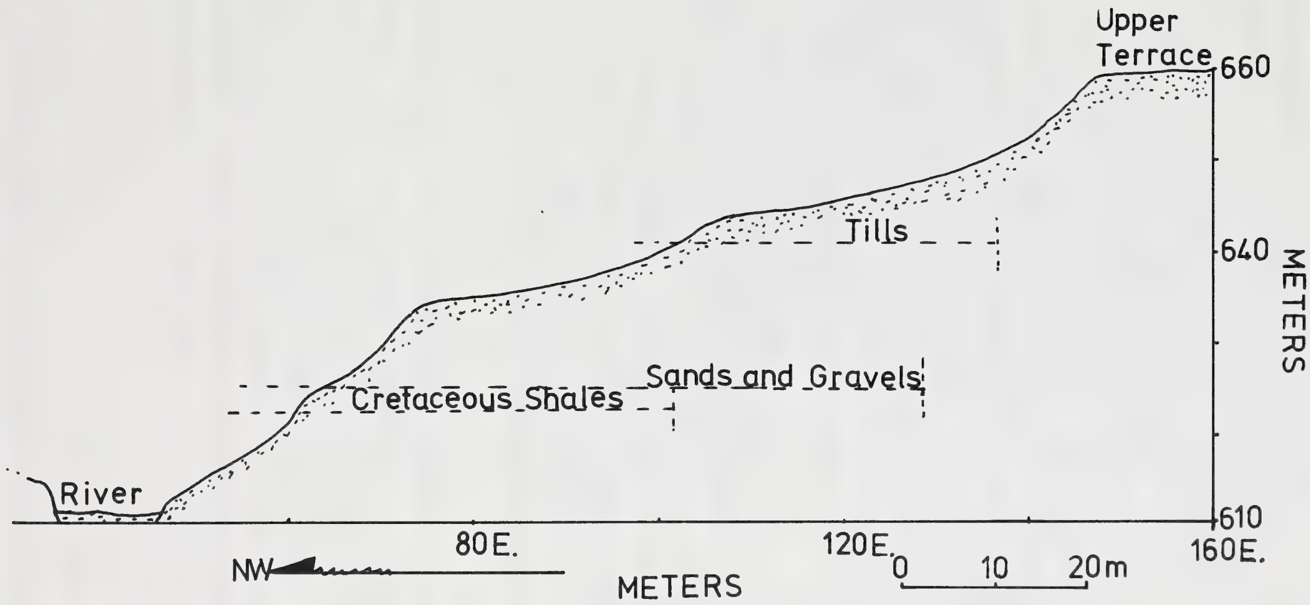


Figure 2. Profile of the east bank of the North Saskatchewan River Valley near the Strathcona Site.

post-glacial terraces in the vicinity. The underlying parent material consists of reworked Saskatchewan Sands and Gravels which are a primary quartzite source (MacPherson and Kathal 1973:4). Immediately underlying the site, occur lacustrine silt and clay till deposits (Westgate 1969: 130). Chernozemic orthic black and gray soils predominate and some old solunetzic soil formations are still apparent (Pawluk, Department of Soil Sciences, The University of Alberta, personal communication).

Previous human disturbance has altered original soils and vegetation (Pollock and Newton 1979). The site is bisected by a large landfill area located immediately to the east. Towards the north, landfill activities and recent building construction have also caused disturbance. In the past FjPi-29 ranged a considerable distance along the North Saskatchewan River and Pine Creek Ravine where a great deal of cultural debris was found in a nearby cultivated field. Presently, approximately 20,000 square meters of the upper terrace is known to contain cultural remains.

Site disturbance is also apparent when the soil profile is examined. An indeterminate amount of the upper profile has been either disturbed or removed by the brush clearing activities (Pawluk, Department of Soil Sciences, The University of Alberta, personal communication) (Figure 3). Pawluk's investigations indicate that between 10 cm to 15 cm of the upper L-H and Ah horizon are missing. Thus, any excavation unit depth comparisons become somewhat tenuous since the amount of soil removed is variable.

Today young trembling aspens grow on the site and are interspersed with saskatoon and chokecherry bushes (Figure 4). Investigations during 1980 show that vegetation has been cleared at least once from the entire site as is suggested by a major brush windrow that runs diagonally across the site (Newton and Pollock 1979). Presumably these clearing activities were undertaken to construct a former wooden radio transmission tower which is marked by surface depressions and iron stakes that originally held guy wires.

PREVIOUS RESEARCH

The Strathcona Site was nearly destroyed when park facilities were constructed but was eventually protected as a cultural resource by the

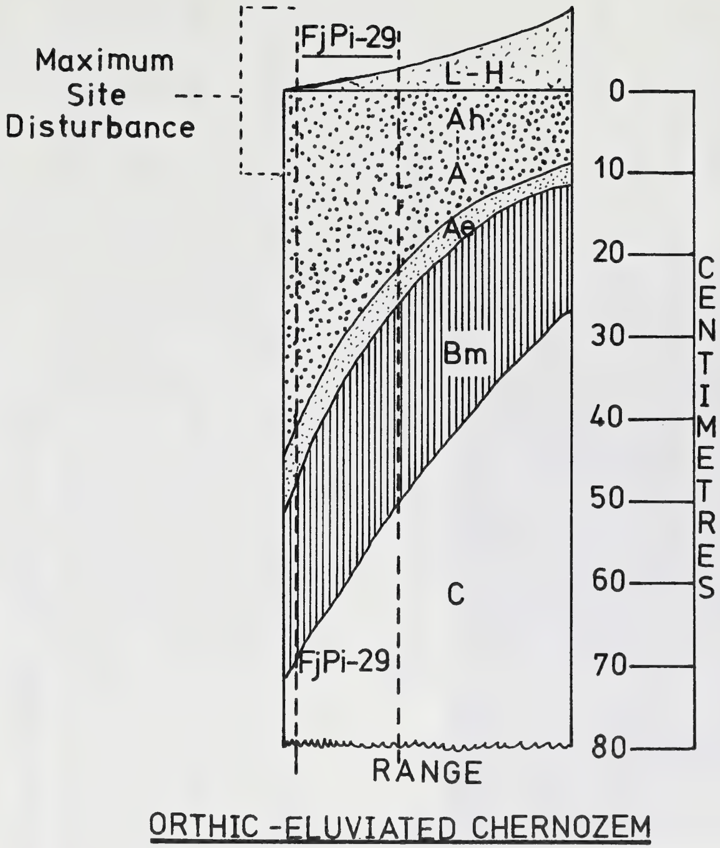


Figure 3. Schematic representation of the Strathcona Site profile compared to soil horizon depth ranges of orthic black/gray, and eluviated chernozems.

Figure 4. Present-day vegetation at the Strathcona Site.

Archaeological Survey of Alberta, Alberta Culture. Initial reporting of the site by ARESCO Limited, Calgary, in 1976 was followed by test excavations and surface collections by Newton and Pollock in 1978. Proposed construction of a laboratory/museum facility, walkway, and a platform overlooking the North Saskatchewan River, resulted in further salvage excavations during the late summer and fall of 1979 by Newton and Ives, the Archaeological Survey of Alberta.

Investigations by Newton and Pollock led them to report that the site was a single component Oxbow lithic workshop. However, further excavations by Newton and Ives in 1979 revised these results and revealed that FjPi-29 was a multi-component site containing:

1. Early twentieth century coal mining activities along the North Saskatchewan River banks.

2. A Late Prehistoric component as evidenced by cord-marked pottery (ca. A.D. 1000 - 19th century).

3. A Late Prehistoric component represented by a Besant projectile point (ca. 300 B.C. - A.D. 700).

4. A Middle Prehistoric component represented by Duncan and McKean

lanceolate points (ca. 2500 B.C. - 1500 B.C.).

5. A Middle Prehistoric component represented by an Oxbow projectile point (ca. 3000 B.C. - 1500 B.C.).

These results showed that the site served as an important lithic extractive/reduction area throughout the Middle and Late Prehistoric Periods where to date well over 15,000 artifacts have been recovered. Presently, the oldest radiocarbon dates are 3730 $\pm$ 80 years B.P. although the presence of an Oxbow component may indicate an occupation date of over 5000 years B.P.

RESEARCH OBJECTIVES, METHOD AND PROCEDURE

OBJECTIVES

Uniqueness of the Strathcona Site as an archaeological interpretive center required that research objectives fulfill public as well as academic interests. Research objectives are divided into: A. Fieldwork; and, B. Lithic analysis.

A. FIELDWORK

1. Completion of four previously unfinished excavation units was necessary (Newton and Pollock 1979).
2. Implementation of a more permanent grid system and a detailed topographic map of the site and surrounding area was required. This work was carried out by professional surveyors from N.A.I.T.
3. Assessment of a proton magnetometer survey that was previously conducted on portions of the site (Gibson 1979). Gibson's research attempted to locate hearth features by detecting high magnetic readings.
4. An attempt was made to separate the various prehistoric components by carefully mapping all artifacts three-dimensionally.
5. A systematic site boundary and area survey was necessary before any long-term research or sampling design could be employed.
6. Excavating units for display purposes and providing general information to the public on the nature and history of the site.

B. LITHIC ANALYSIS

Artifacts and lithic debitage were first described, classified, and then quantified. Such data can then be compared to other lithic assemblages or is easily combined with future site data. Once accomplished, these data, along with data from other lithic assemblages, were organized to investigate the following problems:

1. Lithic debitage is usually neglected but is an important indicator of technological diversity or change. A lithic debitage analysis will determine what flake types and other debitage

attributes can best identify various lithic reduction techniques or raw material selection.

2. Lithic technological change(s) is a measure of cultural evolution since the techno-economic subsystem is considered by many to invariably affect all other cultural subsystems (Steward 1953). Debitage from the Strathcona Site was examined for change in raw material use or change in lithic reduction techniques.

3. Humans continually choose between different modes of energy expenditure to more efficiently exploit their environment. Such choices should be apparent by analysing lithic samples from the Strathcona Site and surrounding area. Did primary decortication occur only on lower terraces nearer raw material sources, or was the entire reduction phase carried out on the upper terrace?

4. Comparison of regional lithic assemblages will lead to a better understanding of site type variability. This preliminary comparison is intended to determine what variables distinguish quarry/workshops from other types of prehistoric sites.

RESEARCH METHODS AND PROCEDURE

FIELD AND LABORATORY METHODS

The entire upper terrace was gridded off into 20 meter squares using the Alberta Township-County Grid System (Figure 5). The east-west baseline is roughly centered and is 5,935,420 meters north of the equator. The north-south baseline is 41,240 meters east of the 114th meridian. Corners of all 20 meter squares were staked by wooden pegs. In addition, two permanent, cemented iron datum bars were placed near the center of the site and on the west end (Figure 5). A topographic map of the area was completed by the N.A.I.T. surveyors (on file at the Archaeological Survey of Alberta, Edmonton). Brush was cleared along each grid line and sometimes along lower terrace grid lines.

Excavations were conducted using one meter squares. Currently no statistically-oriented sampling designs were used for unit placement. Instead, units were located to finish previous excavations, test magnetometer anomalies, and placed near walkways for public viewing (Figure 5).

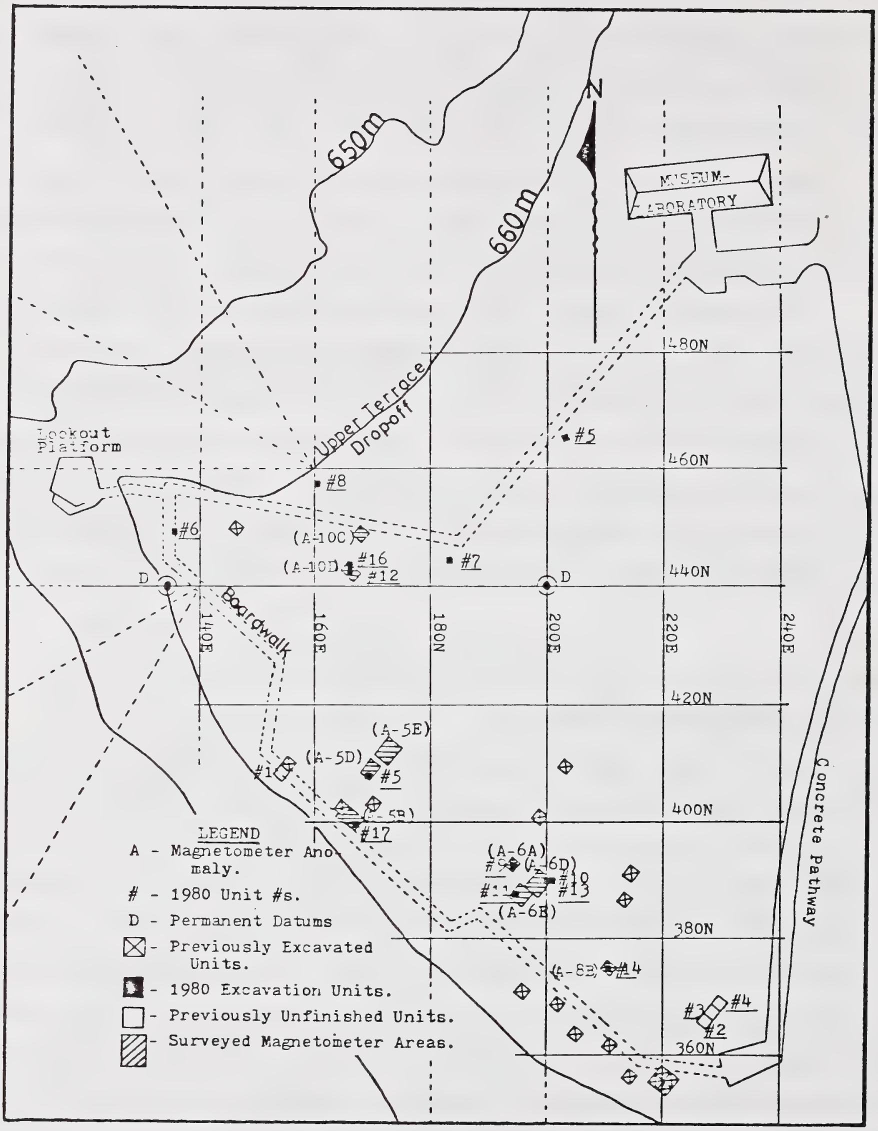


Figure 5. Placement of 1980 excavation units.

Excavations were conducted by trowel; site boundary test units were dug by shovel. Units were excavated in 10 cm arbitrary levels and all artifacts and faunal remains were mapped three-dimensionally. Matrix was screened through a 0.5 cm mesh and five percent bulk samples from each one meter unit were fine-sorted. Also, soil samples were collected from magnetometer test units to conduct chemical analysis for possible iron content.

Artifacts were washed and catalogued in the field. A new cataloguing system was used during the 1980 field season. Artifacts from individual unit levels were separately catalogued. For example, artifact designation "FjPi-29-5-A-1" refers to the first artifact which was found at the Strathcona Site in Unit five, level A. Each excavated unit was given a different number during the 1980 field season; such a system can be indedinitelyexpanded in the future.

Proposed hearth features were examined by placing one or two, one meter units near the magnetometer anomaly (Figure 5). Any potential anomaly-producing feature (charcoal, fire-cracked rock, depressions, or metal objects) was carefully noted from each unit.

Attempts to isolate any site stratigraphy consisted of mapping all artifacts three-dimensionally, then drafting two-dimensional 10 cm wide diagonal profiles for each unit (Appendix I). Artifacts from different unit levels were also compared to determine whether they fit together. Finally, diagnostic point types were vertically plotted to determine whether any depositional trends existed.

Site boundaries are difficult to ascertain, especially when recent surveys indicate that FjPi-29 runs some distance along the North Saskatchewan River and east along Pine Creek. The site may have covered hundreds of acres prior to recent disturbance. However, that portion located west of the landfill area required a more thorough boundary assessment. Thus, a total of 233 test pits, roughly 30 centimeteters in diameter, were dug on lower terraces along established grid lines every five meters (Figure 6). Measurements were taken following terrace slopes and artifacts were recorded from each test pit (Appendix II).

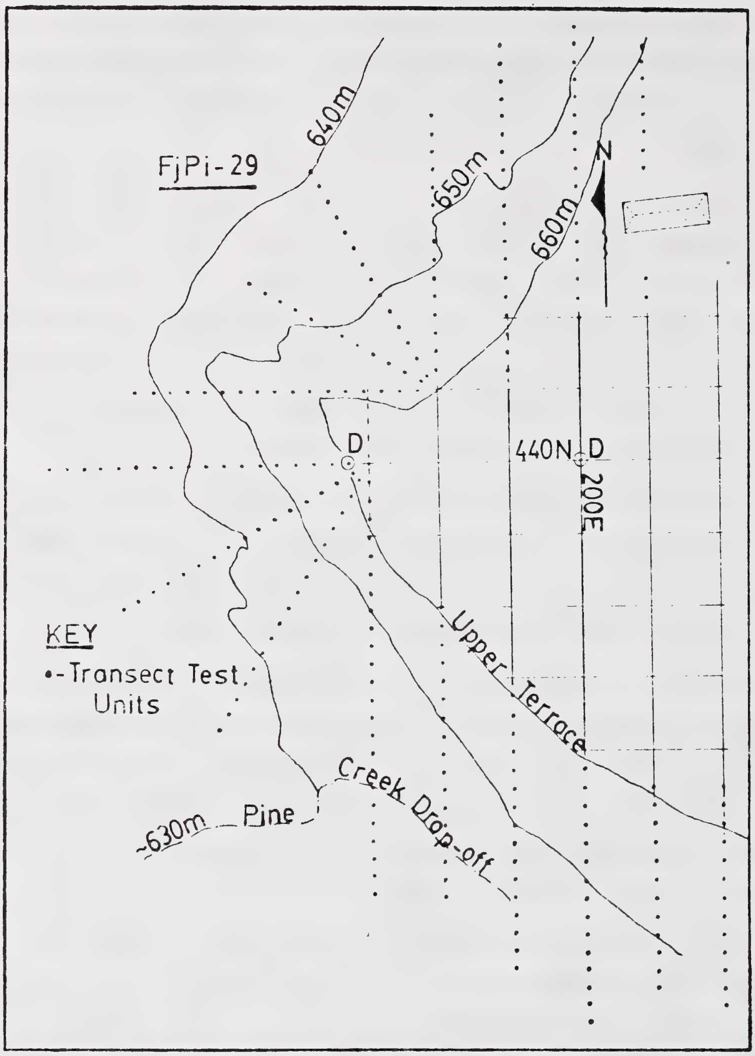


Figure 6. Transect units for site boundary definition at the Strathcona Site.

DATA ADEQUACY AND ANALYTICAL ASSUMPTIONS

No data ever meet all necessary analytical requirements. This study is no exception. At the outset it must be stressed that inconsistency in excavation methods and artifact classifications will often bias results. Conclusions from this study are to be considered preliminary and are subject to change as a more representative sample is collected. Therefore, the study is primarily intended to help others more thoroughly investigate these possible avenues of research in the future.

The 1980 data was generally adequate for fulfilling proposed fieldwork objectives. Only two magnetometer anomalies were not investigated. The first anomaly fell under the public walkway and field time restrictions hampered investigation of the last anomaly. An investigation of possible site stratigraphy was impeded by extensive soil frost-heaving and post-depositional soil disturbance by heavy equipment. Frost-heaving, given Alberta's climatic conditions, can vertically displace objects 10 cm (Brink 1977; Johnson and Hansen 1974; Kaplar 1965; Corte 1963). Also, when conducting the stratigraphic analysis, it was assumed that soil sediment depositional rates were constant at the site throughout the Middle and Late Prehistoric Periods. Such an assumption is based on the presence of relatively stable regional environmental factors (Lichti-Federovich 1970). A relatively small sample was collected for site boundary definition, especially when the entire area sampled is considered (Figure 6). Therefore, the sample may not represent all past activities or accurately measure artifact diversity or frequencies that occurred on lower terraces.

The lithic analysis is restricted by a lack of a sound regional comparative, analytical base. Few North American prehistoric workshop/quarry site studies have been undertaken. Those that come to mind include Meyer's (1970) Illinois Valley chert quarry site, Bucy's (1974) Midvale basalt quarry site, and the Beaver Creek quarry site (Syncrude 1974). Locally, preliminary investigations of the Stony Plain quarry site have been conducted by Losey (1971) who formulated some important methodological questions about such sites. However, presently prehistorians seem to be primarily concerned with specific site objectives. Thus, few rigorous regional comparisons to other quarry or habitation sites have

been made (Ives 1980).

Additional analytical problems are encountered when attempting to construct any meaningful classification schemes which can then be compared to other lithic assemblages. Often such comparisons are difficult since other investigators used a different scheme or simply neglected to document all lithic classes. Secondly, lithic classification variability is also the result of individual research problem orientation. Finally, quantitative bias also deters any regional comparisons since data recovery methods and data recording methods differ amongst researchers.

Ideally, problems with future excavation and classification consistency can be overcome if archaeologists first decide what problems are to be examined and what lithic attributes would be best to solve those problems. For example, it was felt that some knowledge of decortication flake quantities was necessary if workshops were to be compared to other sites; such data are not always recorded. Furthermore, few analysts made any attempts to distinguish between flakes resulting from use of various reduction techniques. Such information is necessary in the future if regional comparisons are to be carried out.

Results reached from the Strathcona Site lithic analysis are considered tentative because of the relatively small sample size and sampling techniques that were used. The excavated area accounts for only 0.15% of an approximate 20,000 square meter area (usually a 5%-10% sample is adequate). Also, statistical inferences are based on the assumption that the sample was randomly chosen and represents the total sample universe. Neither assumption is completely satisfied here. Multivariate statistics were not conducted for the same reasons. A principle component analysis would have isolated those variables that distinguish lithic workshops from other sites, however, the present site sample is too small (Jack Nance, personal communication).

FIELDWORK RESULTS

COMPLETION OF UNFINISHED UNITS

A total of four two meter square excavation units were previously not completed (Newton and Pollock 1979) (Figure 5). In Unit 1 only the upper two-three centimeters had been excavated. In Units 2, 3 and 4, excavations began at six centimeters, 25 cm, and eight centimeters respectively. All artifacts were pedestaled for public display in these units and then removed at the end of the field season (Figure 7).

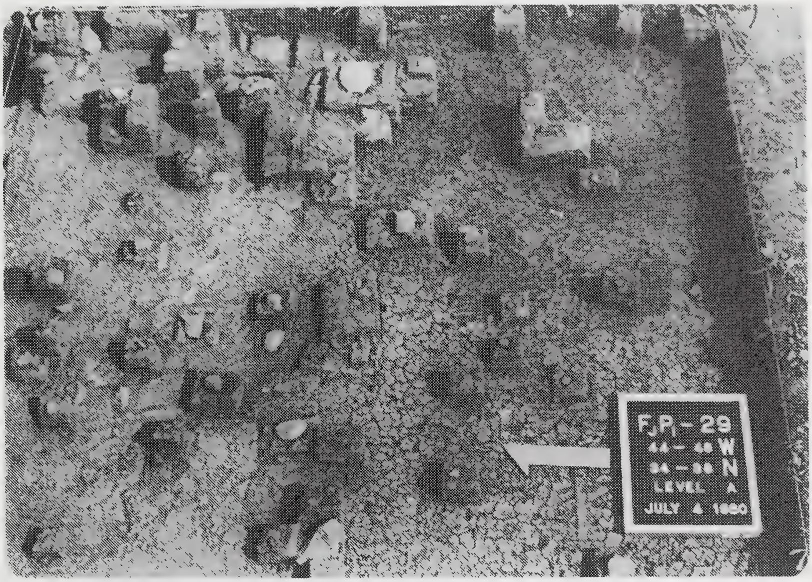


Figure 7. Pedestaled artifacts in Unit 2, Level A, at the Strathcona Site.

Unit 2 contained a cluster of lithic debitage in the northeast corner at depths of 21 cm to 31 cm below ground surface (Figures 8, 9). Quartzite fire-cracked rock was predominant although quartzite flakes, petrified wood flakes and a petrified wood bipolar core were also recovered. In addition, two quartzite hammerstones were found. No charcoal or fired clay soil was associated with the feature, strongly ruling out the possibility that it represents a hearth. Instead, a combination of different material flake types, coupled with hammerstones, strongly suggests that the area served as a lithic knapping station.

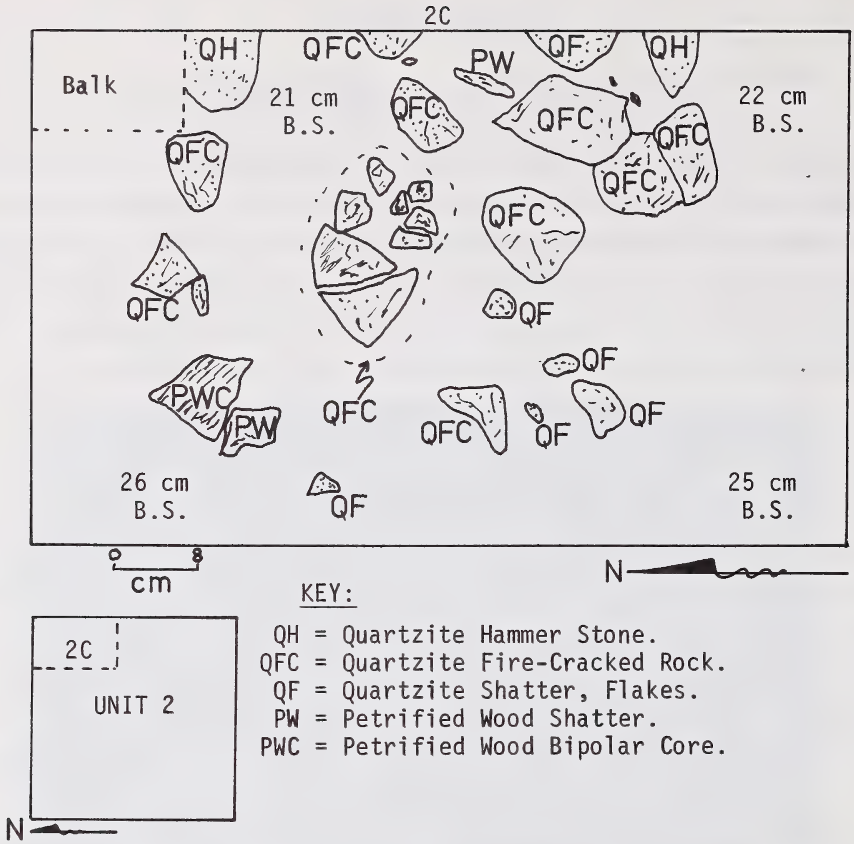


Figure 8. Plan drawing of lithic cluster in Unit 2.

Figure 9. Lithic cluster in the northeast corner of corner of Unit 2.

PERMANENT GRID IMPLEMENTATION

The site's permanent grid follows the Alberta Township-County Grid System. This system uses the equator and 114th meridian as the east-west and north-south baselines respectively. The upper terrace was gridded off into 20 meter squares whose corners were staked by wooden pegs. Brush was cleared along all grid lines on the upper terrace. Two permanent cemented iron datum stakes were placed near the center and at the west end of the site (Figure 5). All old unit coordinates were recalibrated to the new grid system on a topographic area map.

PROTON MAGNETOMETER ASSESSMENT

Results obtained from the proton magnetometer survey were not encouraging. No hearth features occurred in the seven anomalies that were examined. Figure 5 shows magnetometer survey areas and placement of test units. In anomaly area '10D' a .22 calibre metal rimfire cartridge was found 20 cm below ground surface. A one meter long barbed wire fragment occurred on the surface near anomaly '6A'. Anomalies '5D' and '6D' showed slight depressions that occurred between three to five centimeters below the surrounding clay B horizon and approximately 40 cm to 50 cm below ground surface (Figure 10). It is questionable whether these depressions were man-made or whether they were formed by falling trees which uprooted the surrounding area (Figure 11). No traces of charcoal or soil firing was present in either depression. It is possible that these lower disturbed areas caused unusually high magnetic readings.

No apparent reasons for high magnetic readings were found in the remaining anomaly test units (Units 11, 14 and 17). Fire-cracked rock occurred in minimal quantities (see Appendix III), but no fired soil or charcoal was present in these units. Conceivably, hearths were a greater distance from anomalies than was originally thought. Thus, these features may have been missed by the 1980 test units.

STRATIGRAPHIC ANALYSIS

PROJECTILE POINT DEPTHS AND DEPOSITIONAL RATES

At best the Strathcona Site cultural deposits can only be divided

Figure 10. Cross-section of depression in Units 10 and 13, Level E.

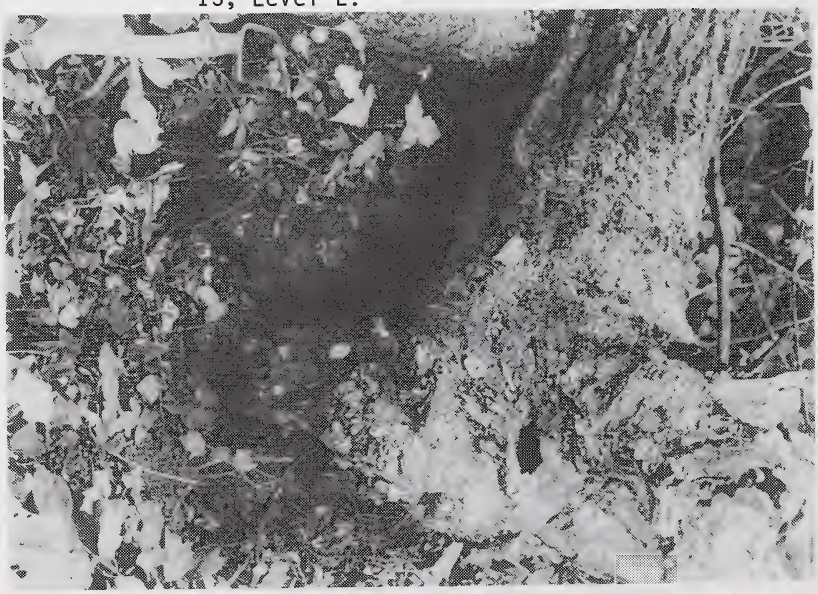


Figure 11. Example of resulting soil disturbance from a recently fallen tree.

into arbitrary temporal ranges. These ranges are determined from site depositional rates and regional cultural phases. For example, it is estimated that the mean A horizon is 35 cm thick and has a range between 30 cm and 40 cm (see Figure 3). Similar figures are also computed for undisturbed chernozemic soil profiles near the site. Artifacts are deposited from the top of the Ah horizon to the top of the B horizon. Thus, it is estimated that during a 5500 year period one centimeter of soil is deposited every 157 years. A mean soil depositional range can be calculated from this data (Figure 12). The temporal range for such a depositional rate is between 4710 B.P. and 6280 B.P., or 1570 years B.P. (Figure 12).

An approximate temporal and soil depth range is established for each point type when projectile point time ranges are placed over mean soil depositional rates (Figure 12). All seven diagnostic projectile points, presently recovered from the site, are plotted on the graph. These results indicate that there exists a rough correlation between projectile point depths and postulated depositional rates. However, if ranges for any variables are slightly changed then the results also drastically change.

LITHIC DEPOSITION

Results from vertical artifact plots were disappointing. Diagrams were visually very difficult to assess when artifacts were plotted in a three-dimensional matrix (Figure 13). This method was abandoned in favor of two-dimensional artifact plots (Appendix I). Diagonal sections (15 cm wide) were taken from each unit. All artifacts were plotted from this diagonal strip. It was assumed that a narrow vertical strip minimized topographical variation which certainly would have affected any stratigraphic patterns. Also, it is more likely that artifacts that occur in this strip will be contemporaneous.

Little vertical artifact separation exists in most units (Appendix I). Instead, there is an almost continuous vertical artifact distribution. Exceptions are found in Units 12, 16 and 17 where definite distributional breaks are apparent. Furthermore, no major trends are apparent when artifacts from all unit diagonals were combined (Appendix I).

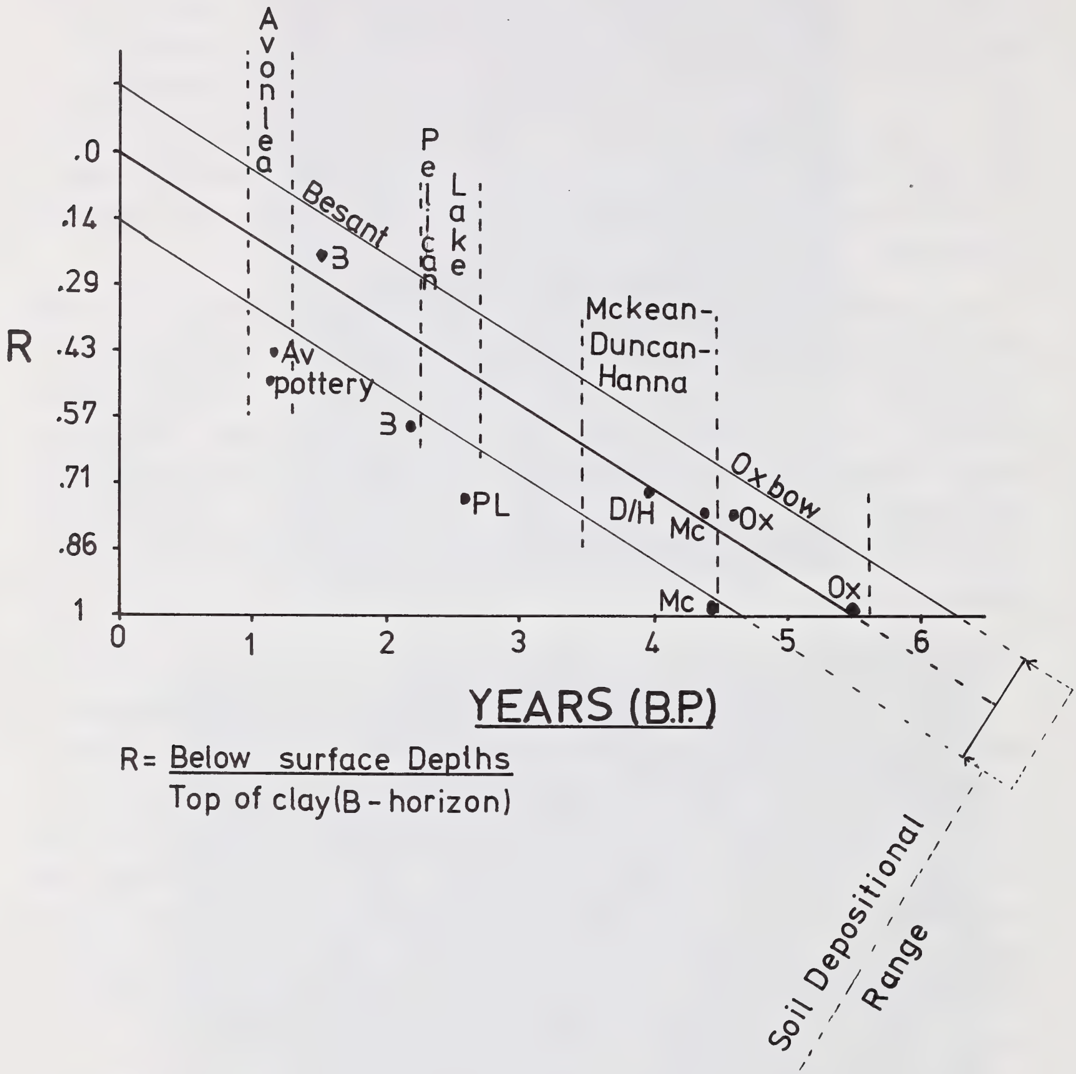


Figure 12. Postulated soil depositional rate and projectile point plots.

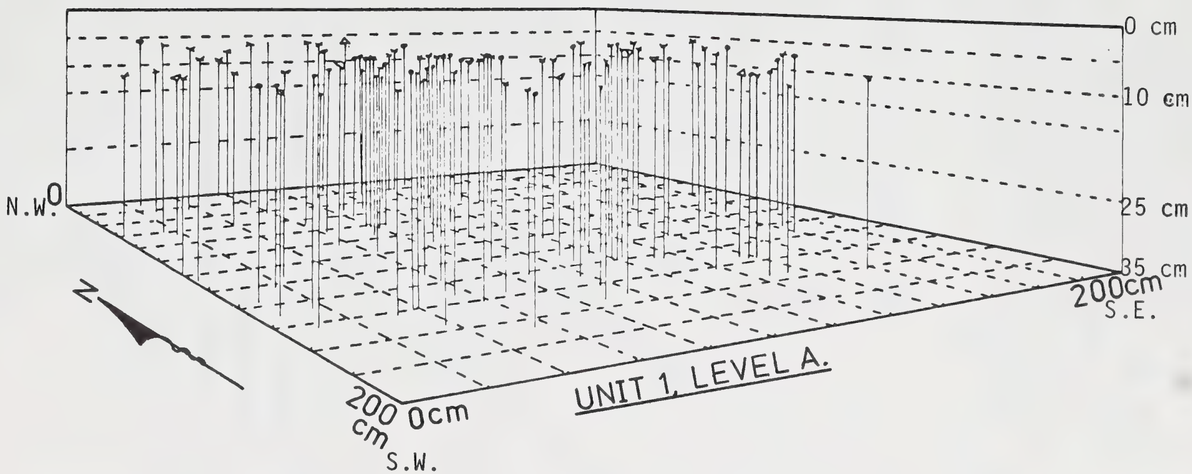


Figure 13. Example of a three-dimensional representation of artifacts from Unit 1, Level A, the Strathcona Site.

The major cause for a lack of stratigraphic patterns is a relatively slow soil depositional rate coupled with frost-heaving activities. Numerous flakes were found vertically aligned which helped minimize upward pressures exerted upon them by frost heaving. Sometimes artifacts from various levels fit together. For example, fire-cracked rock from Unit 1, Level C and D, fit together but occur 10 cm apart vertically. Such a range of vertical displacement probably destroyed any existing stratigraphic patterns.

SITE BOUNDARY ASSESSMENT

A total of 70 artifacts and 13 faunal remains were recovered from 233 lower terrace test units (Appendix II). These units were divided into 20 meter-wide isobars which run parallel to the upper terrace (Figure 14). Artifact presence/absence ratios were computed for each isobar. As was expected, ratios constantly decrease toward the lower terraces (Figure 14). Artifact ratios from the north and south sides were compared and higher than average ratios were found on the south side (Table 1). Also, the north and south side ratios are significantly different from one another (Table 1). Finally, individual south line transect ratios were generally higher than the north line transect ratios (Table 1). These results suggest that human activities were greater on the south side near Pine Creek.

Relatively large faunal concentrations (nine bone fragments) occur on lower south terrace (220 east - 290 north to 295 north) (Figure 6). This area may represent an associated kill site or isolated faunal remains which have washed downstream from a presently unknown source. Further investigations are required.

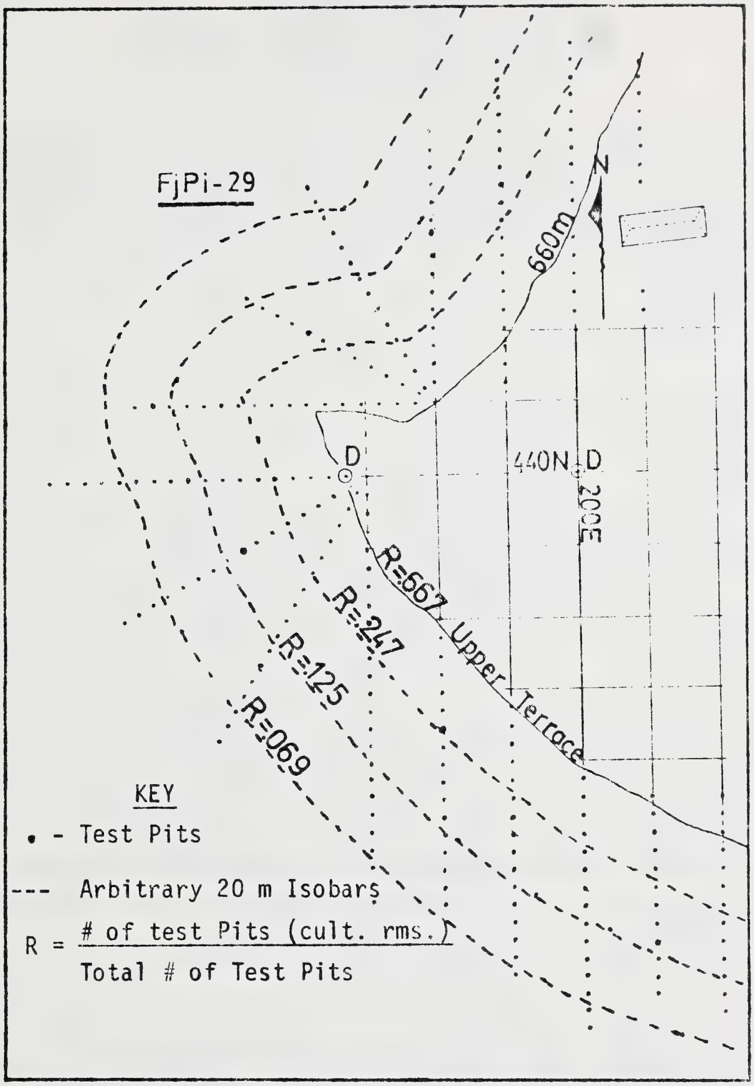


Figure 14. Arbitrary 20 meter isobars and corresponding artifact ratios.

TABLE 1

ARTIFACT PRESENCE/ABSENCE RATIOS
AND DIFFERENCES BETWEEN RATIOS TESTS

	Grid Line	Units with Artifacts Present	Total Units	Ratio
SOUTH SIDE	240 East	3	17	.18
	220 East	7	14	.50
	200 East	5	14	.36
	180 East	5	16	.31
	160 East	3	17	.18
	140 East	6	22	.27
	140 East, 30°	3	16	.19
	140 East, 60°	2	16	.13
	Total	34	132	$\bar{X}$ = .25, S = .12
NORTH SIDE	440 North	2	21	.10
	460 North	1	17	.06
	160 East, 30°	1	12	.08
	160 East, 60°	1	12	.08
	160 East	4	14	.29
	180 East	3	20	.15
	Total	12	96	$\bar{X}$ = .13, S = .09
	North and South Total	46	223	$\bar{X}$ = .21, S = .10

South Side: $Px = .26$, $Q = .74$, $\sigma^2_{P_x} = .0015$, $n = 132$.

North Side: $Py = .13$, $Q = .87$, $\sigma^2_{P_y} = .0011$, $n = 96$.

$$\sigma(Px - Py) = \sqrt{\sigma Px^2 + Py^2} = \sqrt{.0015 + .0011} = .05$$

$$\pm Z = \frac{(Px - Py) - (p_x - p_y)}{Px - Py}$$

$$\pm 1.96 = \frac{.13}{.05} = 2.6$$

H_0: $Px - Py = 0$

H_1: $Px - Py \neq 0$

Reject H_0. There is a significant difference between the two proportions.

LITHIC ANALYSIS

INTRODUCTION

Lithic material was classified with reference to past studies conducted by Honea (1965a, 1965b), Bucy (1971), Losey (1971), Newton and Pollock (1979), Heitzman (1980) and Ives (1980). Minor classificatory changes were made to more thoroughly investigate the previously proposed research objectives. These changes were based on data that was gathered by conducting lithic reduction experiments at Simon Fraser University and the Strathcona Site. Replicative experiments clearly demonstrated that the lithic reduction sequence is a continuum which is difficult to break into arbitrary analytical units (Losey 1971:141). Consequently, the classification system was designed to isolate certain lithic attributes which would document lithic reduction stages along this continuum. Also, the system was intended to distinguish between various lithic reduction methods.

LITHIC REDUCTION AND CLASSIFICATION

Collins (1975) proposed that lithic reduction techniques be described in a linear fashion by identifying a series of successive steps. Muto's (1970) 'blank-preform-product' reduction model resembles Collin's linear model. Ives (1980:7-2) suggests that these models be applied to parkland quarry/workshops since many quartzite blanks-preforms-bifaces have been found at such sites (Newton and Pollock 1979; Losey 1971).

REDUCTION

Artifacts are manufactured by using bipolar percussion, hard hammer or soft hammer percussion, and by pressure flaking. Lithic by-products include various flake types, core types and shatter; reduction methods should be perceptible when examining these lithic by-products. Often, all three reduction techniques are used to make the artifact. Sometimes a choice between reduction techniques exists. Selection of one technique over others depends on raw material attributes, required energy expenditure and the desired final products.

Once raw materials are selected, then either a hand-held hard hammer percussion or a bipolar percussion technique is used to remove a spall

or flake from the cobble. Cortex is removed by primary and secondary decortication with a hard or soft percussor. Additional usable flakes are removed from the core until it is exhausted. Next, the artifact is thinned by percussion until an optimal thinness is obtained. Additional trimming and final shaping is accomplished by pressure flaking. Artifact maintenance is also carried out by pressure flaking or sometimes by percussion.

Lithic reduction can stop at any stage; artifacts can be used at each stage and then further reduced. Finally, lithic reduction can take place in a particular area or it can be conducted over a large geographical area, at different sites.

CLASSIFICATION AND DEFINITIONS

The above summary sufficiently isolates some basic lithic types that might occur from each successive stage of reduction. First, attributes were chosen that would help identify different reduction methods and stages. Then the assemblage was divided into: 1) Artifacts, consisting of various tool types and blanks; 2) Debitage, which consists of various flakes and shatter; and, 3) Fire cracked rock.

Some controversy exists over the identification of bipolar reduction techniques and whether they can be distinguished from other percussion methods (Crabtree 1972; Sollberger and Patterson 1976; White 1977). A bipolar method was used on a range of material sizes and generally in the initial stages of reduction. By-products include exhausted bipolar cores, flakes and shatter. The former category exhibits flake removal and battering marks on one or both ends and is slightly convex in profile. Generally these cores have no negative bulbs of percussion. Bipolar flakes are quite flat, have very diffuse bulbs or no bulbs of percussion. Sometimes both ends show more crushing and hinge fracturing than normally occurs on other percussion flakes. Platforms are small or nonexistent and have highly variable angles. Moreover, these angles are often oriented in such a manner that make it impossible to produce them by other percussion techniques. Battering marks on hammerstones are centered instead of located near an edge. Anvils are also required for this technique.

Direct hand-held percussion can be identified from cores, flakes and percussors. Cores often exhibit more than one striking platform for flake removal. Negative bulbs of percussion also occur. A multi-platform core is formed when many flakes are removed at various angles (Honea 1965b:30). Percussion flakes have well defined striking platforms with angles less than 90^{o}. The degree of pronouncement of bulbs of force changes with the degree of percussor hardness. Presence or absence of lipping just below the striking platform is also dependent on percussor hardness (Crabtree 1972:44). Other flake features include force waves and fissures if materials are quite vitreous.

Pressure flakes are difficult to positively identify. They are usually small and thin, have small platforms and diffuse bulbs of percussion. A ridge often occurs along the dorsal face and serves to guide flake removal (Crabtree 1972:15). Flakes will quickly spread from the original point of force without such ridge control. Thus, pressure flakes are more uniform, show better definition, and are more diagnostic than percussion flakes; distinctness of these features will vary with material type.

The assemblage was also examined to identify reduction stages. Debitage was divided into four basic flake types. Primary decortication flakes are completely covered with cortex on the dorsal side and vary in size. They are removed during the initial stage of reduction. Secondary decortication flake dorsal faces are partially covered with cortex, also vary in size and are processed by artifact thinning or by platform rejuvenation; two flake varieties occur. The first variety is partially covered by cortex on the dorsal face and is produced when the dorsal side of the artifact is thinned. The second variety exhibits cortex on the striking platform or proximal end. Flakes are formed when material is removed from the ventral side but cortex has not yet been removed from the dorsal face. Platform rejuvenation flakes help move the artifact's line of gravity toward the center which results in a better striking platform for flake removal on the dorsal face.

Reduction flakes have no cortex. They are either removed from the dorsal or ventral side. These flakes represent the next stage of artifact trimming or thinning. Retouch flakes are removed by direct

percussion but usually by pressure flaking. They are small (often less than 15 mm long), thin and have small platforms with no cortex. Such flakes are produced by final artifact shaping/thinning or from edge re-sharpening.

Shatter is composed of non-diagnostic fragments which vary considerably morphologically, have little regularity, and display no discernible flake attributes (Crabtree 1972:90). Shatter occurs at each reduction stage but probably decreases in frequency as the final artifact shaping stage is approached. Shatter exhibits variable amounts, or no cortex.

Spalls consist of large flakes that are either removed by bipolar or direct percussion from cobbles or cores. Edge modified flakes were only noted when it was apparent that modification did not occur from other activities such as trampling. Fire-cracked rock was grouped into size ranges according to material types. Rock surfaces displayed heat crazing and cracking and a blocky fracture line.

QUANTITATIVE SUMMARY

A total of 5794 artifacts were recovered from 29 square meters excavated at the Strathcona Site in 1980. A summary of the 1980 lithic industry is presented in Table 2. Individual unit lithic summaries are presented in Appendix III and Appendix IV. Quantitative results from the bulk sample analysis are listed in Appendix V.

Over six lithic material types are represented (Table 2). By far the most predominant material is quartzite (74.2%), followed by petrified wood (19.1%). All other materials occur in relatively small quantities.

A total of 226 artifacts comprise only 3.9% of the total lithic assemblage. The majority of artifacts (71.2%) are made from quartzite, followed by petrified wood (9.7%), mudstone (7.0%) and chert (5.3%) artifacts respectively. The primary artifact category consists of cores (30.5%), followed by bipolar split pebbles (25.2%), hammerstones (17.7%), edge modified flakes (11.9%) and bifaces (6.6%) respectively. All other artifacts occur in minor quantities. A total of 184 (3.2%) pieces of fire-cracked rock are mainly quartzite and are less than 50 mm in

TABLE 2

LITHIC SUMMARY: FjPi-29

ALL UNITS

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.	1							1
BIFACES f.	14							14
UNIFACES c.	2							2
UNIFACES f.								-
EDGE MOD. FLAKES	19	5		1		2		27
SIDE SCRAPERS						1		1
END SCRAPERS						3	1	4
PROJECTILE PTS.	2	2	1					5
BIPOLAR SPLIT PEBBLES	44			4		7	2	57
CORES	10-30$_{x}$	5-10$_{x}$	5	3-3$_{x}$		3$_{x}$		69
HAMMERSTONES	30-6?						2-2?	40
ANVILS	1						1?	2
OTHER	2			1			1	4
TOTAL ARTIFACTS	161	22	6	12	-	16	9	226
#* = Platform (direct percussion). #$_{x}$ = Bipolar.								
Primary Decortication Flake	162-27*-41$_{x}$	69-1*-3$_{x}$	2	4		5-4$_{x}$	6-1*	325
Secondary Decortication Flake	288-101*-54$_{x}$	12-1*	2	2-1*-1$_{x}$		4-2$_{x}$	1	469
Reduction Flake	381*-46$_{x}$	4-2$_{x}$	17*-2$_{x}$	19*-1	3*	6*-4$_{x}$	4*-3$_{x}$	492
Retouch Flake	275	2	18	7	6	8	1	317
Shatter	2568	921	10	15	7	27	105	3653
Spalls	5-6							11
Other	49	32	2	8	1	6	19	117
Total Debitage	4003	1047	53	58	17	66	140	5384
TOTAL LITHIC INDUSTRY	4164	1069	59	70	17	82	149	5610

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	109	60	11	3	1	-	184

diameter (Table 2).

The remaining lithic assemblage is comprised of debitage which makes up 92.9% of the entire assemblage. Shatter (67.8%) is the predominant debitage category followed by various flake types which have relatively similar values (Table 2). Quartzite is the major debitage material type, followed by petrified wood (19.4%). Other materials occur in relatively low quantities.

RAW MATERIAL SOURCES

Raw materials come from exposed sections of the Saskatchewan Sands and Gravels, other till deposits and deeper underlying Cretaceous shale deposits (MacPherson and Kathol 1973; Westgate 1969). Quartzite, argillites and chert comprise approximately 98% of these deposits in some parts of the province (Westgate 1969). Generally, the Edmonton area Saskatchewan Sands and Gravels are found near the bottom of preglacial valleys (Prest 1970:692), but quartzite cobbles are sometimes also found in till deposits located on higher terraces. Petrified wood sources occur on Saskatchewan River lower terraces where Cretaceous shales (Wapiti Formation) are exposed (Bayrock et al. 1977:277). However, suitable raw material exposures are not always uniformly distributed throughout an area (Newton and Pollock 1979:19). Thus, surficial geography often dictates availability of these materials. A cursory examination of material sources in the Strathcona area indicates that a great deal of effort is required to find suitable raw materials.

Quartzite cobbles occur in various sizes, shapes and display a range of siliciousness. If material selection occurred prehistorically, it should be relatively easy to detect since such factors as cobble size and shape should vary significantly from natural deposit samples. Presumably, large, flat, fine-grained quartzite cobbles were selected that had relatively few natural fault lines. A preliminary examination of the Saskatchewan Sands and Gravels revealed that few cobbles occur that have all the above ideal characteristics. Many of the fine-grained cobbles have natural fracture lines and are unsuitable for artifact production. Finally, none of the quartzite cobbles that were examined from these deposits were as vitreous or fine-grained as some lithic material

recovered from the Strathcona Site. These observations suggest that many cobbles were heat treated prior to reduction. Also, heat treatment may have fused natural fracture lines in cobbles. However, further heat treatment experiments should be carried to examine this latter inference.

Petrified wood was selected for degree of siliciousness and size. This material has natural cleavage planes which occur along growth rings, making it easy to fracture longitudinally. Often petrified wood contained highly silicious areas. Here natural growth rings are fused together into nodules which physically resemble chalcedony or amber. Similar nodules were present in the 1980 lithic assemblage and evidently were used for artifact manufacture. Therefore, in many cases lithic material that was categorized as chalcedony may be amber that came from petrified wood silicified nodules.

Other raw materials are found in relatively small quantities. Small chert, mudstone and quartz pebbles and nodules occur in Cretaceous outcrops and Saskatchewan Sands and Gravels. Bipolar reduction is used to split these small pebbles to remove usable flakes. Most hammerstones are manufactured from quartzite but a few percussors are made from granite or sandstone. Experiments with sandstone hammerstones show that this soft material grips striking platforms better and produces thinner flakes.

ARTIFACT DESCRIPTIONS

BIFACES AND UNIFACES

A total of fourteen biface fragments and three complete bifaces were made from quartzite. Specimens closely resembled those bifaces that were found during past field seasons at the Strathcona Site (Figures 15, 16, 17). Various stages of completion were represented. Some specimens were shaped and bifacially flaked while others exhibited variable amounts of cortex. A few fragments displayed lipping on the break which may have occurred from end shock. Another fragment had a large build-up of mass on the dorsal surface. Unsuccessful attempts to remove this lump probably resulted in an accidental snap. All remaining biface fragments were relatively undiagnostic and consisted of point or edge fragments.

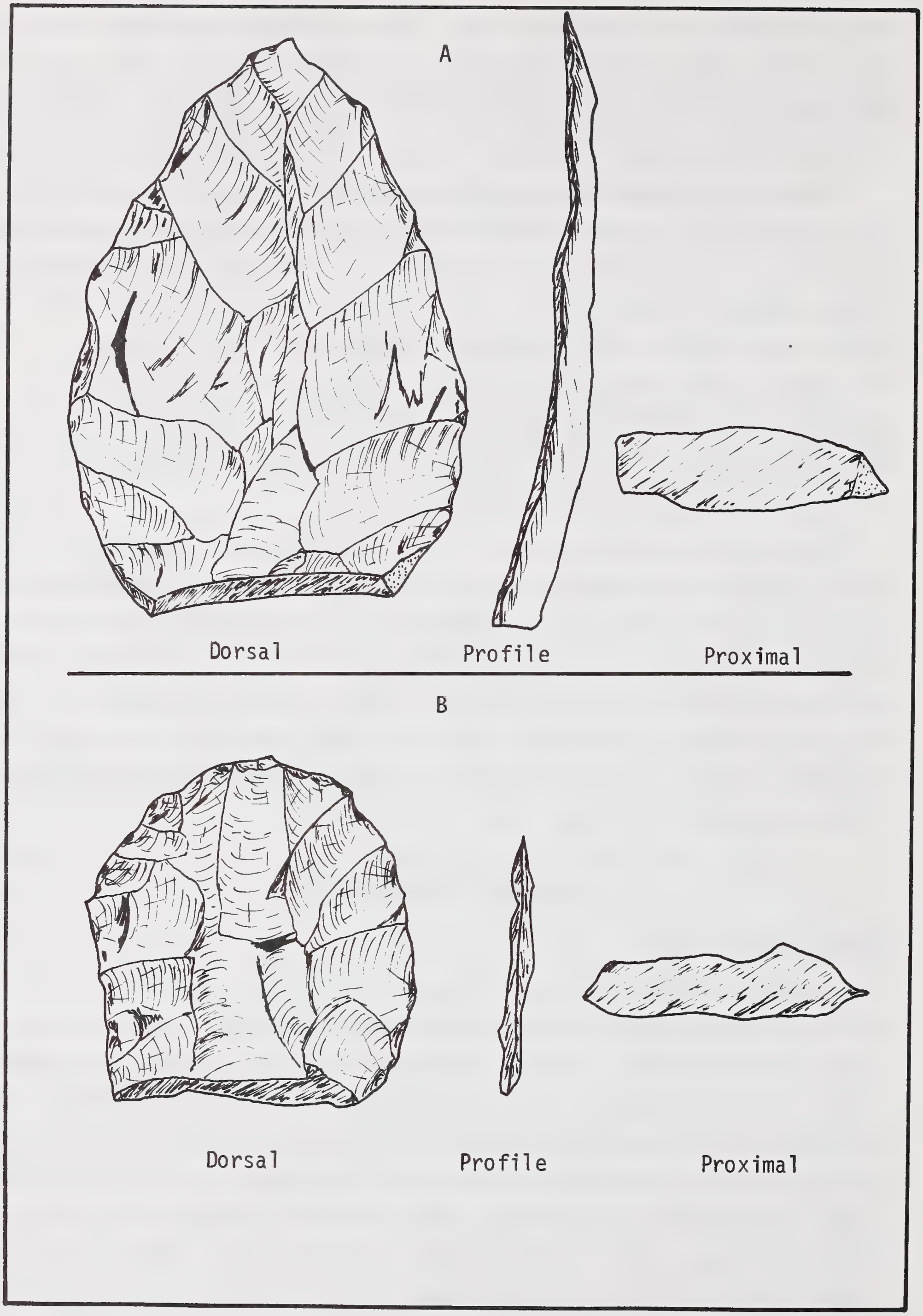


Figure 15. Biface fragments and complete bifaces (actual size).

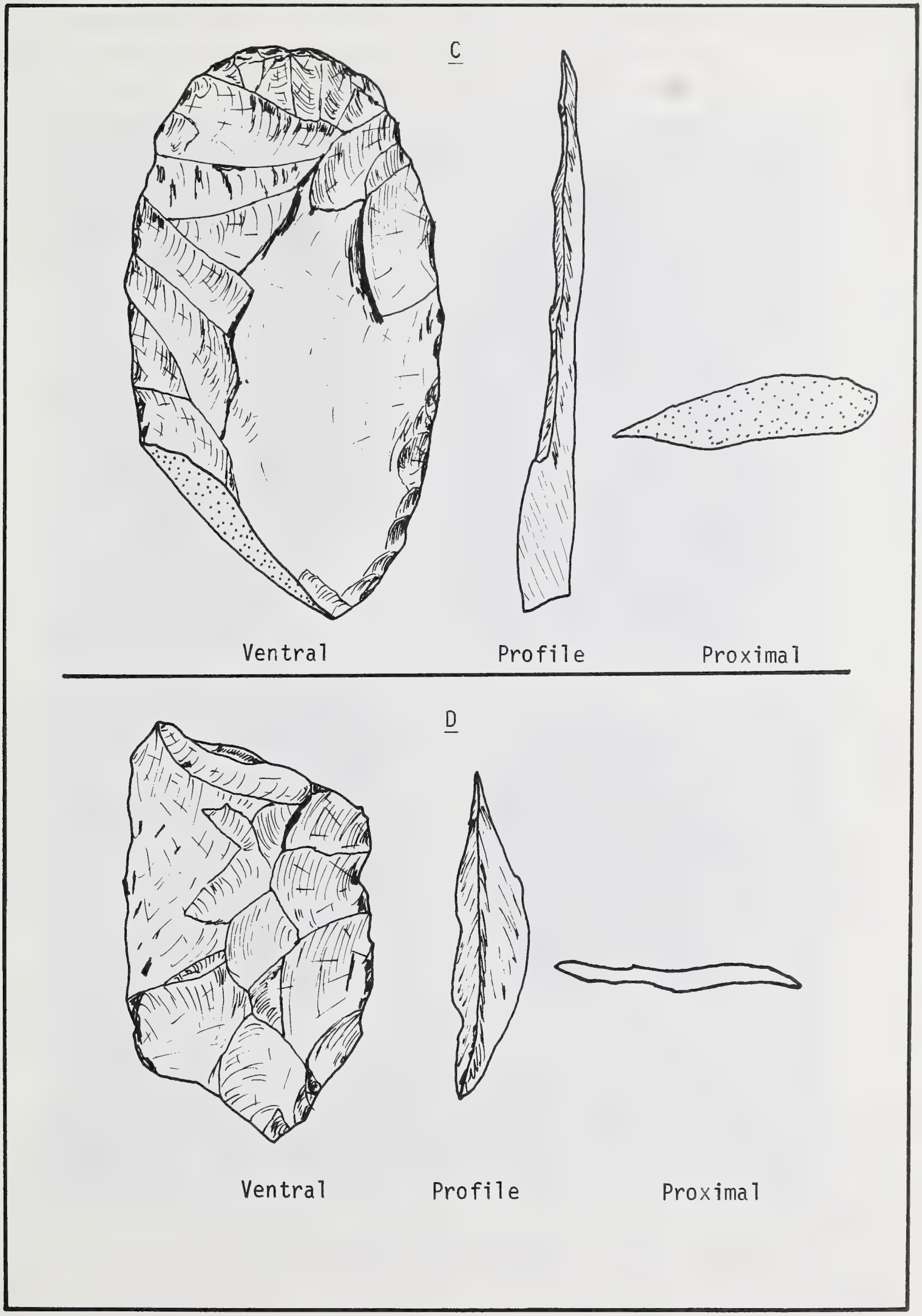


Figure 16. Biface fragments and complete bifaces (actual size).

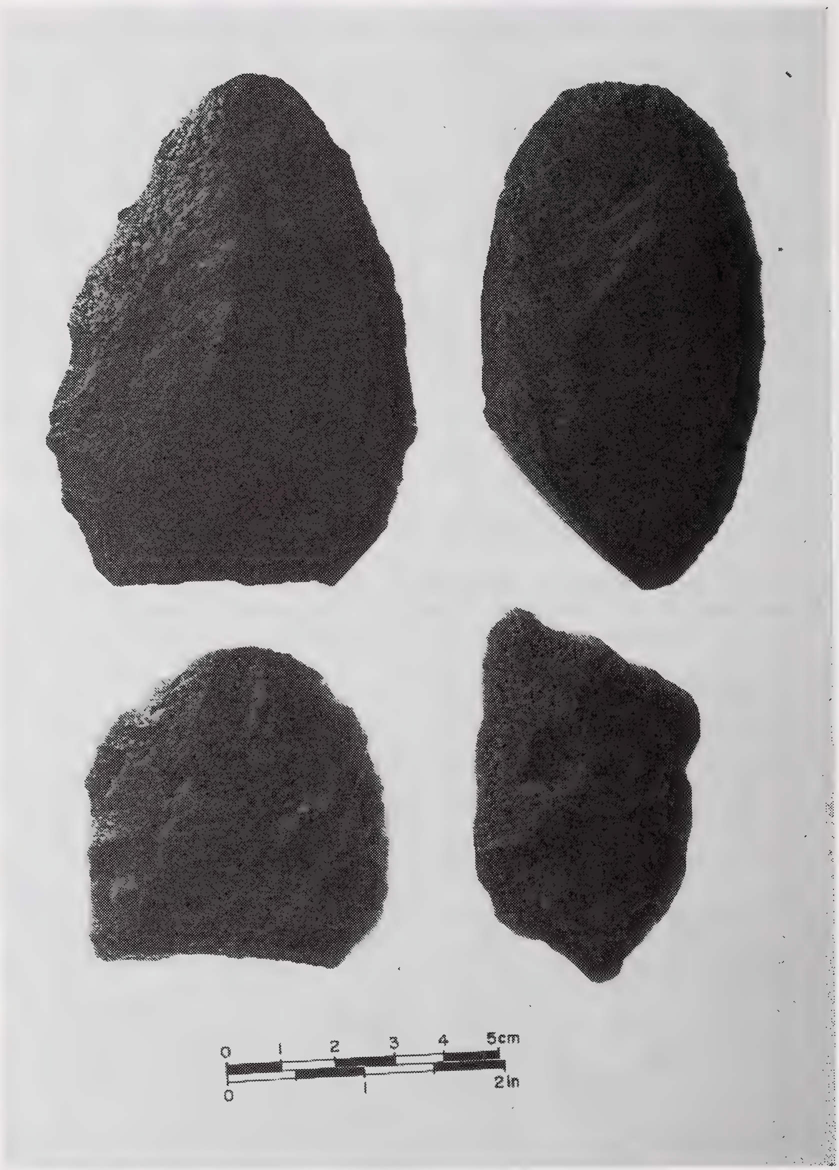


Figure 17. Biface fragments and complete bifaces.

Complete bifaces ranged from roughly made percussion flaked specimens to finished pressure flaked, ovate, trapazoidal and triangular-shaped bifaces. These artifacts were either manufactured from quartzite cobble halves or large spalls and flakes that were removed from cobble cores. Evidence for this reduction method was apparent from the very flat biface ventral surfaces and convex dorsal faces. Moreover, bifaces that were made from large spalls or flakes were often thicker on one end (Figure 16c). Therefore, apparently no bifaces or blanks were manufactured by completely reducing an entire quartzite cobble to an artifact.

Cortex from quartzite unifaces is removed around the edges on the dorsal face (Figures 18, 19). Some specimens may represent a stop in biface reduction. The artifact was not finished because difficulties in reduction processes were foreseen (Figure 18A). Examination of uniface edges reveal that some abrasion and dulling occurs which presumably is the result of chopping or scraping activities.

EDGE MODIFIED FLAKES

Most edge modified flakes were made from quartzite, but also some petrified wood and mudstone specimens occurred. Irregular edges were sometimes formed from use. These flakes showed no flaking regularities and edges displayed step or hinge fractures and rounding from use. In addition, both the ventral and dorsal surfaces were modified. Other flakes were deliberately retouched which helped strengthen cutting or scraping edges. They were made from both decortication and reduction flakes. No edge concavities or spokeshaves were evident in the lithic assemblage.

SCRAPERS

This artifact category is divided into side scrapers and end or thumbnail scrapers. The majority of scrapers are made from a soft, gray mudstone (Figures 20, 21). The side scraper is made from a large decortication flake and is unifacially retouched on both lateral edges on the dorsal face (Figure 20A). Two mudstone end scrapers have very steep distal edge angles and are retouched along the lateral edges. The other two scrapers are very flat and are unifacially retouched on the dorsal face, along the distal and lateral sides (Figure 20D, E). All specimens are made from flakes.

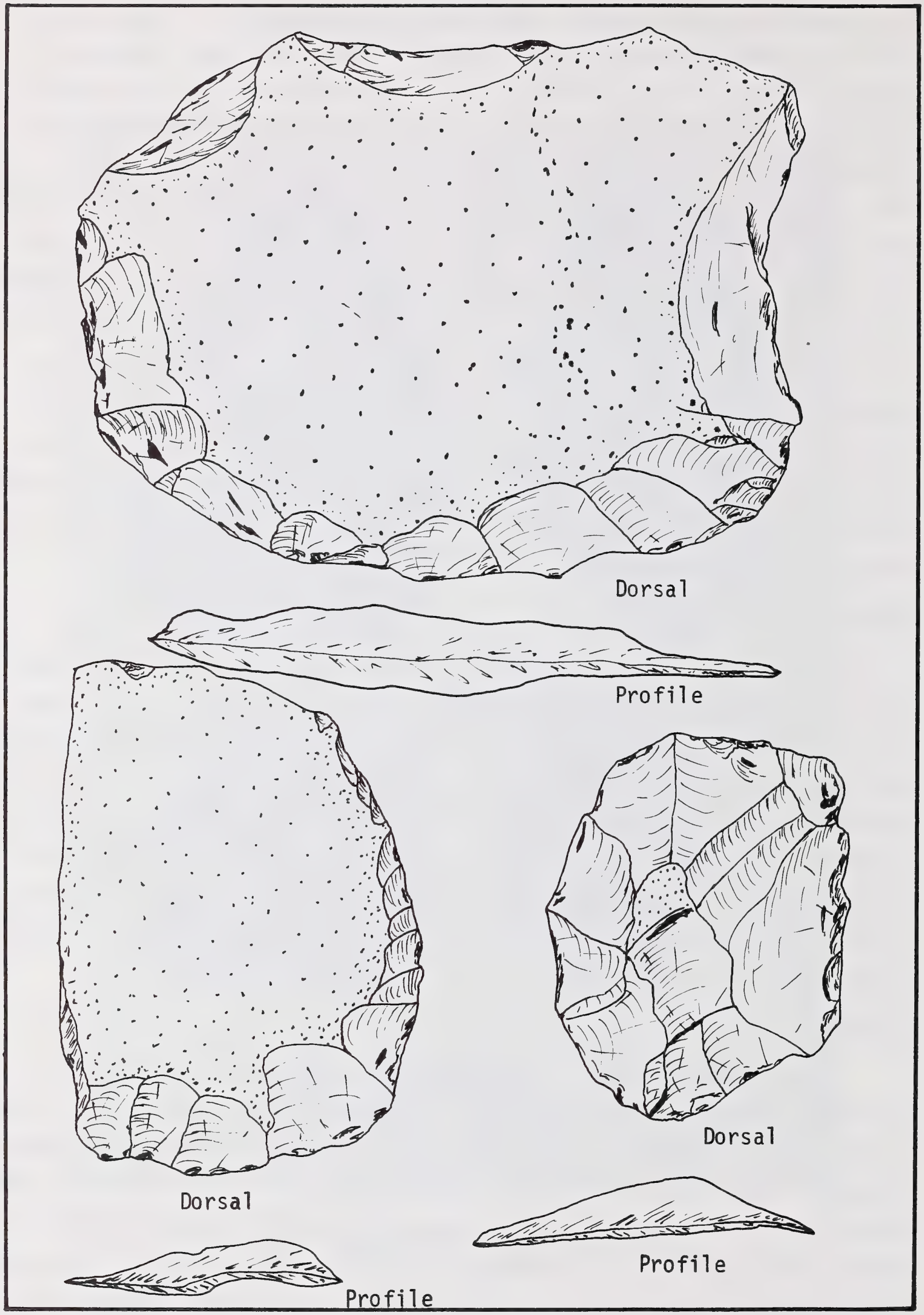


Figure 18. Unifaces from the Strathcona Site (actual size).

Figure 19. Unifaces from the Strathcona Site.

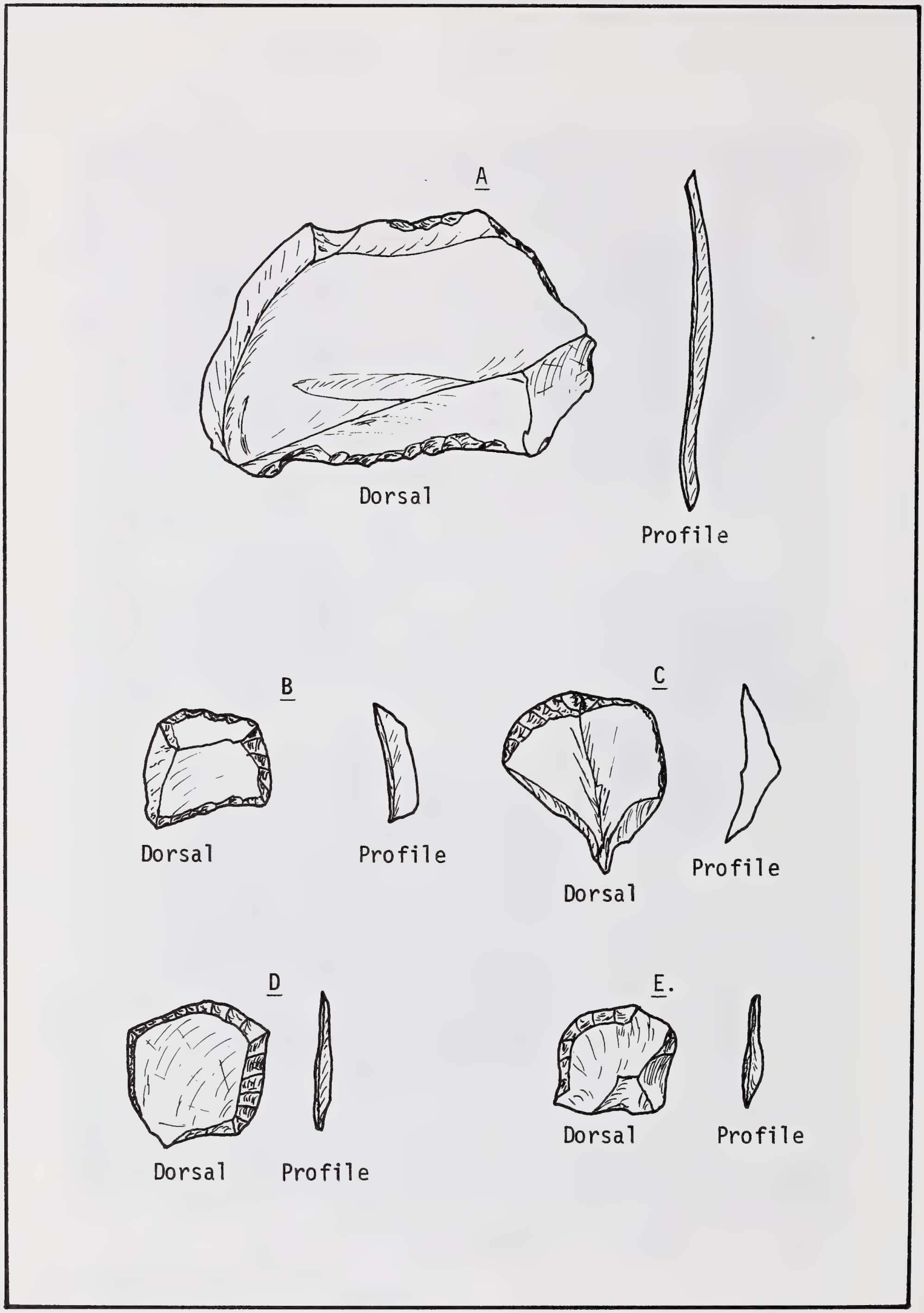


Figure 20. Side scrapers (A) and end scrapers (B - E).

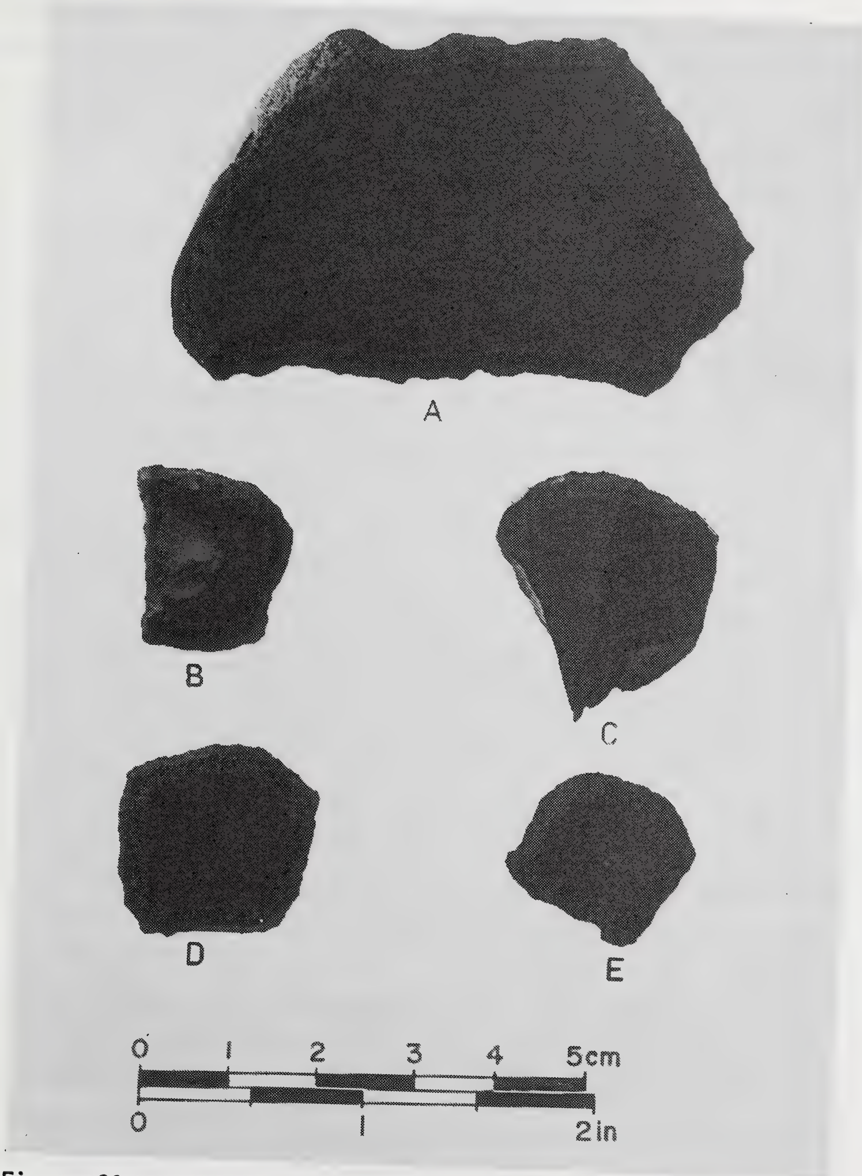


Figure 21. Side scrapers (A) and end scrapers.(B - E).

PROJECTILE POINTS

Only two of the six projectile points recovered are culturally diagnostic (Figures 22, 23). The others include two unfinished quartzite triangular-shaped points, a petrified wood basal fragment and a petrified wood point which is either an unfinished projectile point preform or a piercer (Figure 22C - F). However, this specimen is probably a projectile point preform since no edge wear is apparent and the base is thinned, resembling completed projectile points.

The two diagnostic projectile points include a chalcedony Pelican Lake point fragment and a petrified wood Avonlea specimen (Figure 22A, B). The Pelican Lake fragment is basally thinned, has large, blunted corner notches and a relatively narrow stem. The base is slightly narrower than the blade and the lateral edges are straight. The tip is step fractured instead of snapped, suggesting that the break is caused by some sort of impact force. The second point is an Avonlea variant since it has slightly different characteristics than most Avonlea points (Byrne, personal communication). Side notches are very shallow and slightly rounded. The base is thinned and flat instead of slightly concave. These slight differences may be related to temporal factors or they are caused by difficulties that are encountered when working with petrified wood.

SPLIT PEBBLES

A relatively large sample of split pebbles was recovered from the 1980 excavations and previously by other investigators (Newton and Pollock 1979:47-49; Ives 1980). Only those specimens were listed that showed bipolar fracturing features such as impact scars on one or both axes. Many more split pebbles were not quantified simply because they could have been naturally fractured. These pebbles consisted of granite, sandstone or other materials that were not commonly used to manufacture artifacts. Moreover, such split pebbles were often found in the clay till underlying the site. Their appearance in cultural deposits can best be explained by frost heaving activities which mixed them with other cultural remains.

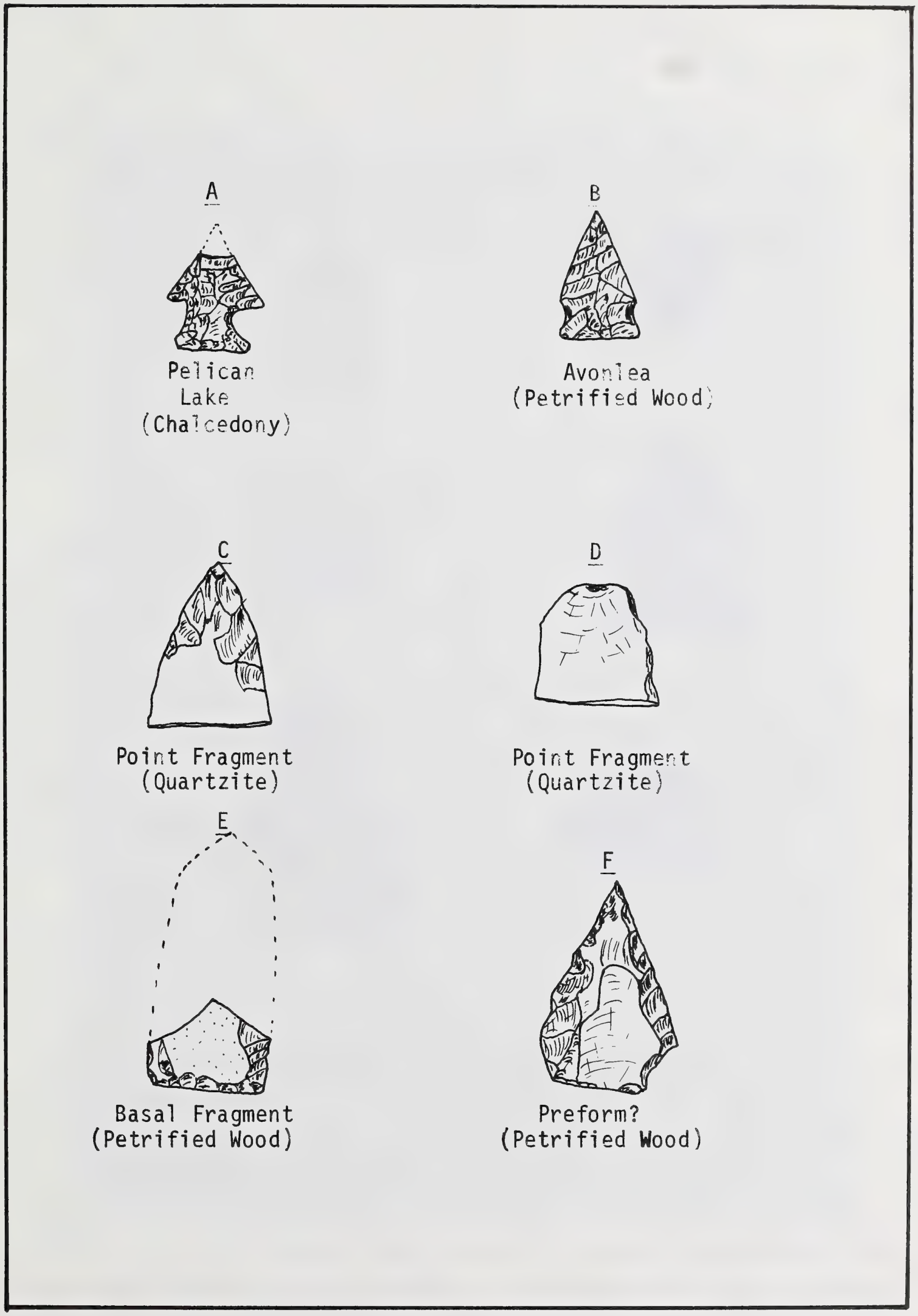


Figure 22. Projectile points and point fragments (actual size).

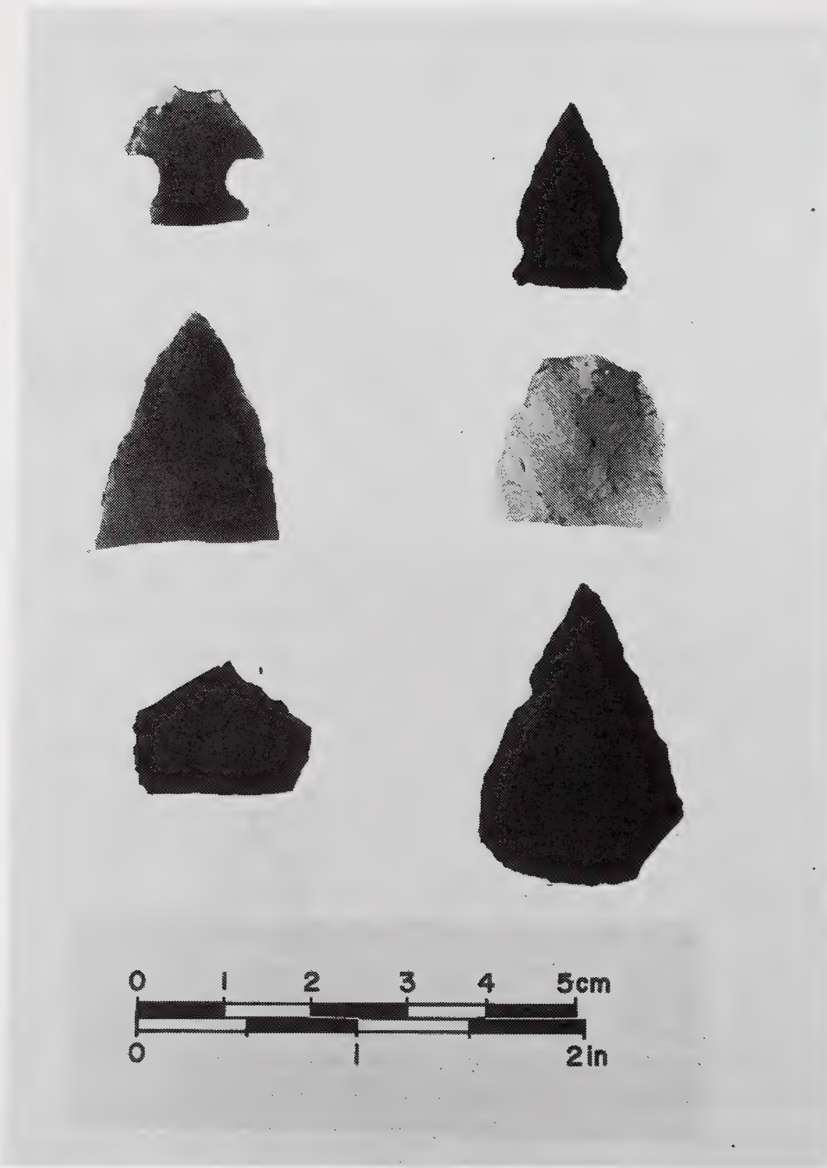


Figure 23. Projecile points and point fragments.

CORES

This category is divided into bipolar, multiplatform and microblade or blade cores. Quartzite was the most commonly used material although many bipolar cores are also made from petrified wood.

Bipolar cores are the predominant type (66.7%), are made from various material types and occur in different sizes (Figures 24, 25). A bipolar reduction method is necessary to split smaller pebbles and petrified wood but it was also used for fracturing large quartzite cobbles and then for removing workable flakes or spalls from cores. Thus, bipolar cores occur in various stages of reduction. On some specimens only a few cortical flakes are removed while on others flakes are removed until the core is exhausted.

It has been suggested that the degree of bipolar core reduction is often a function of later using exhausted cores as preforms for other tools such as wedges or pièces esquillées (Forsman 1970:20). It is argued here that bipolar cores are solely the end product of flake production. Examination of small tool types does not support Forsman's contention since the majority of these tools are manufactured from flakes. Newton and Pollock (1979:41) also seem to misunderstand the function of the bipolar reduction method and bipolar cores. They believe that pebbles were reduced to produce a core that could be used as a tool preform. These inferences are based on little descriptive or analytical data.

Multiplatform cores occurred in low quantities and in a variety of reduction stages (Newton and Pollock 1979:50). They were initially split by a bipolar method and in this respect resembled specimens found at the Stoney Plain Quarry Site (Losey 1971:143). Some specimens at the Strathcona Site have prepared platforms which served to remove additional flakes or spalls by direct percussion. As more flakes were removed, flake scars began to intersect and overlap one another at various angles until a blocky core with multiple platforms resulted. With this technique a large cobble was initially split longitudinally by bipolar percussion and then fractured transversely to produce a usable platform for flake removal (Figures 26, 27). Such cobble reduction may have more efficiently utilized material from large, thick, round cobbles

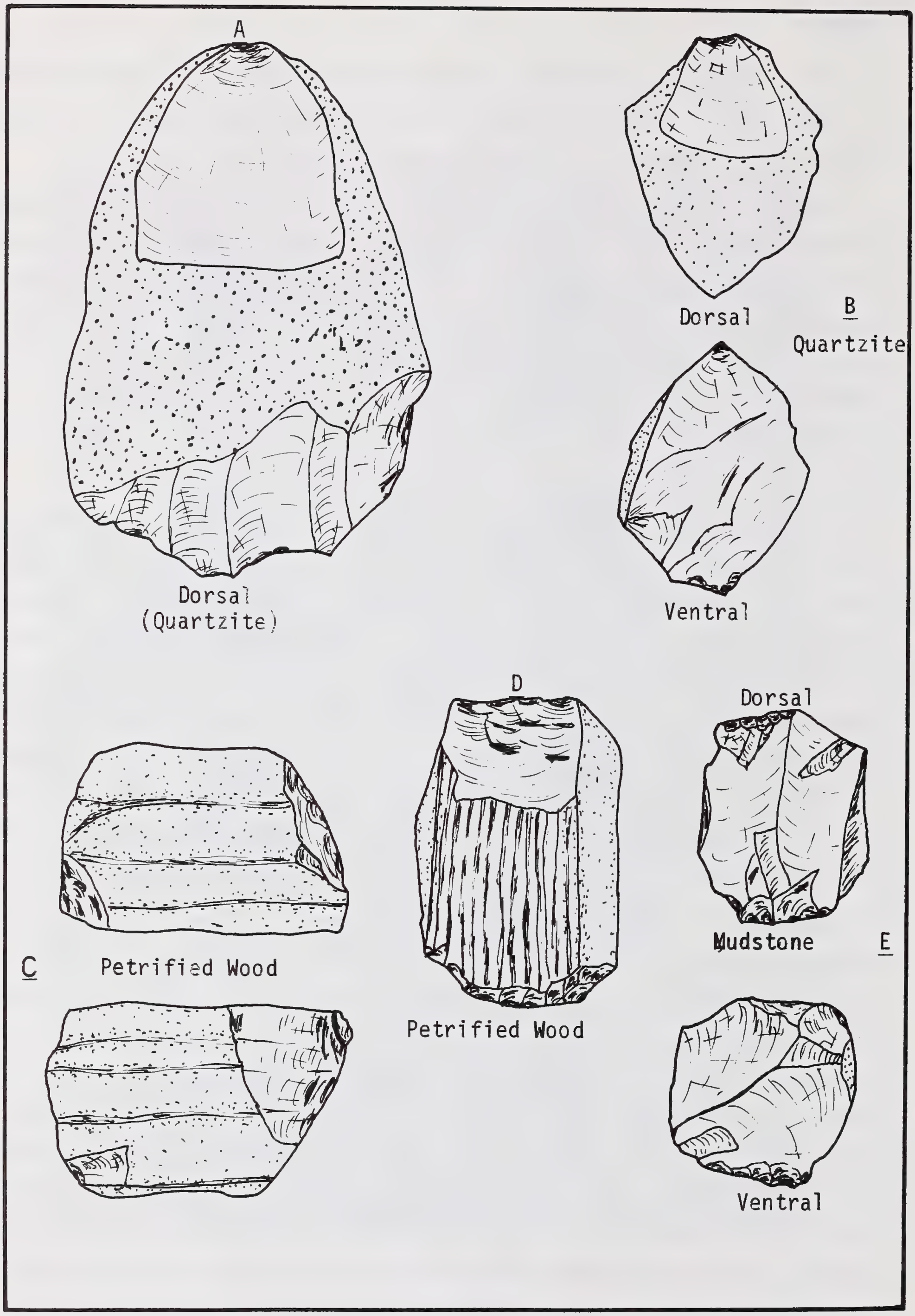


Figure 24. Bipolar cores of various materials (actual size).

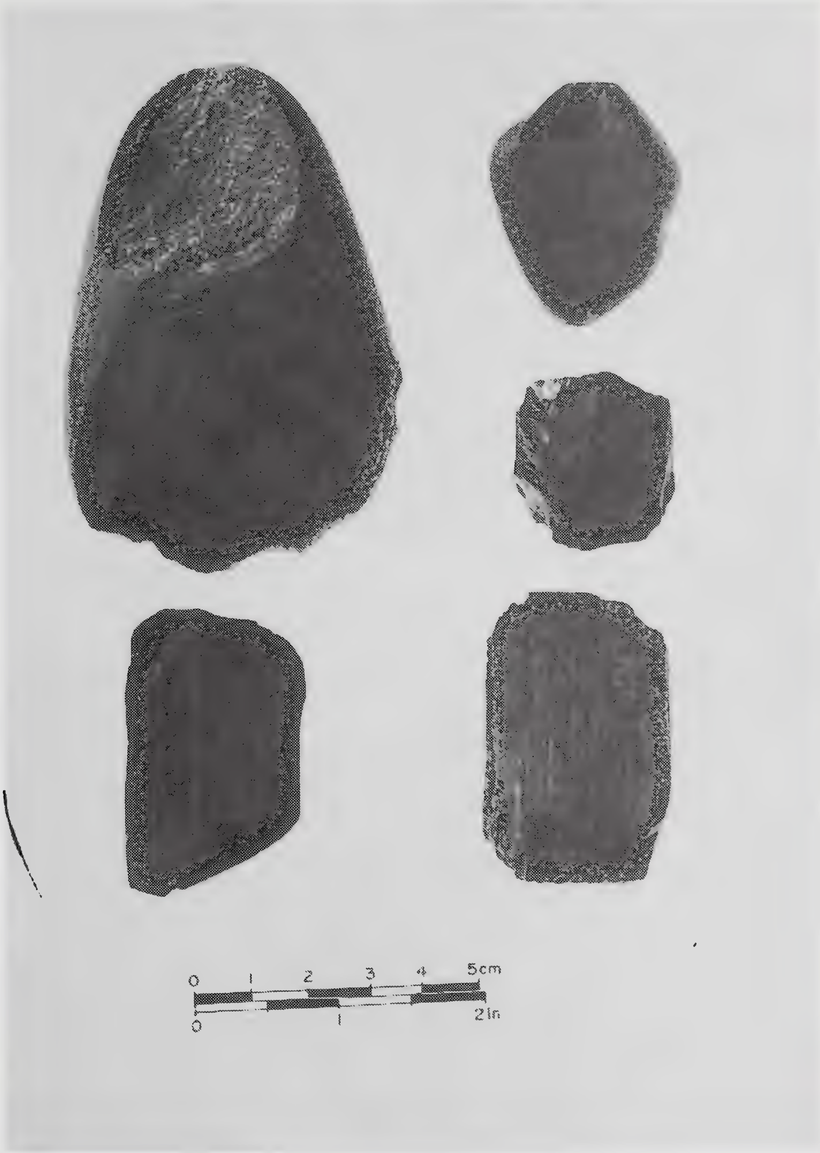


Figure 25. Bipolar cores of various material types.

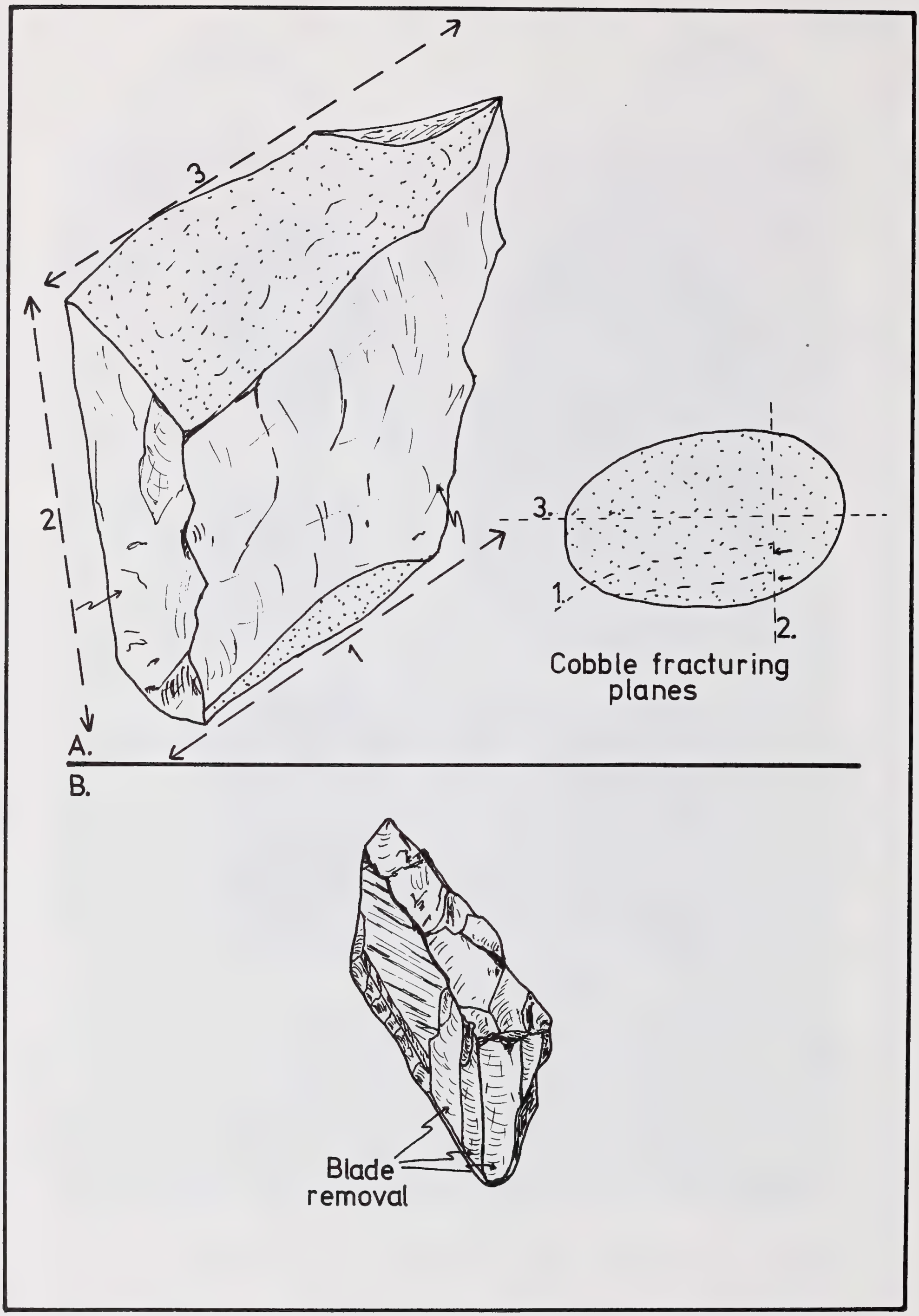


Figure 26. A. Multiplatform quartzite core showing platform preparation. B. Exhausted petrified wood core (Drawings are not to scale).

Figure 27. A. Quartzite multiplatform core. B. Exhausted petrified wood core.

which were difficult to reduce by other methods. Such a reduction technique would also produce some flakes that had very little cortex, and seems to have been used to produce the flake for the biface in Figure 16C. This biface is thin and straight in profile and only has some cortex on the proximal end.

A petrified wood blade core was also recovered (Figures 27, 28). The core is roughly rectangular-shaped proximally and tapers towards the base forming a keel (Sanger 1968). Blades that removed from this core shape will taper slightly and are pointed on one end. Some platform grinding or faceting was also present (Semenov 1964). The platform contained a small round hole near the edge where the blade was pushed or punched off with a pointed object (Figure 28).

PIÈCES ESQUILLÉES

This artifact type has previously not been distinquished from bipolar flakes and is often difficult to identify. However, three pièces esquillées were identified and consist of two quartzite specimens and a silicious petrified wood cortical fragment. Fundamentally, pièces esquillées are tools and differ morphologically from bipolar cores (MacDonald 1968; Hayden 1980). Hayden (1980:2-3) believes that this tool type:

- is made from flakes, blades, or tool fragments which are useless as cores.
- rarely has primary flakes removed that would be usable as microtools.
- flakes removed are badly hinged or stepped and only extend down a fraction of the dorsal or ventral face.
- often display the ventral scar of the original flake.

Recent lithic bone splitting experiments support Hayden's findings and indicate that pièces esquillées are made when ordinary flakes are hammered into bone. This activity causes platform crushing and some flake removal which makes these objects roughly similar to bipolar cores. However, they still retain some of the above characteristics. Furthermore, wedges generally have battering marks along numerous parts of their edge (Pyszczyk n.d.). Therefore, it is suggested that based on these differences, this artifact type should be separated from bipolar

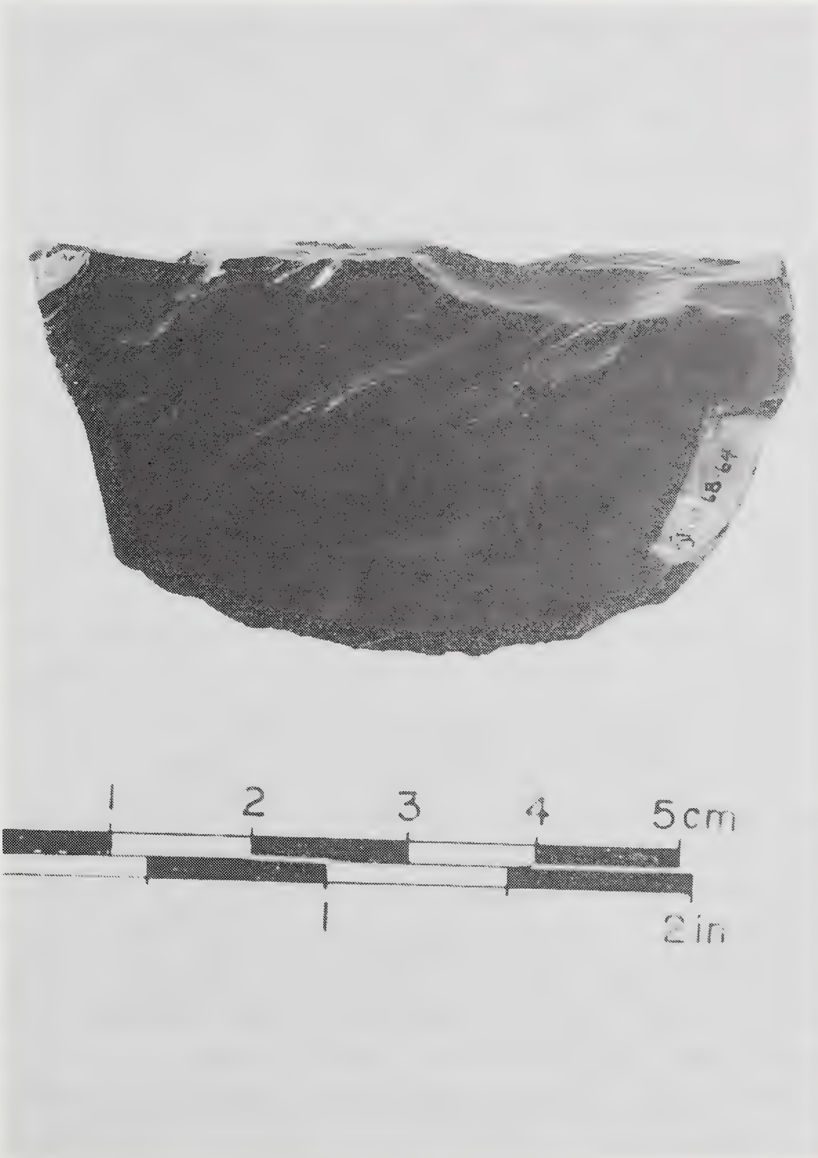


Figure 28. Close-up of a petrified wood blade core.

cores in the future since they are morphologically and functionally different.

The three <u>pièces esquillées</u> are made from decortication flakes, have at least two badly battered or crushed ends and exhibit numerous step fractures (Figures 29, 30). The petrified wood specimen has battering marks on more than two edge areas.

<u>HAMMERSTONES AND ANVILS</u>

From a total of 40 hammerstones, eight identifications were questionable as they did not show distinctive battering marks but yet were the right shape and size for percussors. Most hammerstones (90.0%) are made from quartzite but two irregular-shaped sandstone specimens were also recovered. Hammerstone shapes are generally ovate or round and occur in variable sizes. Variability in size and shape is required for different stages of reduction. Large hammerstones are required to remove large flakes while smaller lighter percussors will remove smaller flakes. The degree of hardness is also important since sandstone hammerstones grip platform edges better and generally produce thinner flakes (Flenniken, personal communication). In fact, some researchers believe that soft stones can be used throughout the percussion reduction sequence. Moreover, no morphological differences are apparent between these flakes and billet flakes (Flenniken 1980).

Anvils are relatively rare. They are identifiable by their relatively large size and impact scars that occur near the center of the stone. However, it is sometimes difficult to distinguish between anvils and hammerstones by the position of battering marks alone. Battering marks may occur near the center of the hammerstone if it is used for bipolar reduction. Reduction experiments suggest that anvils should be relatively large, flat and heavy to provide maximum stability. Therefore, these latter attributes are the most diagnostic in identifying stone anvils.

<u>POTTERY</u>

A total of three small fired clay fragments are tentatively identified as pottery (Byrne, personal communication). These fragments have no exterior markings or any particular shape. The sherds have some grass

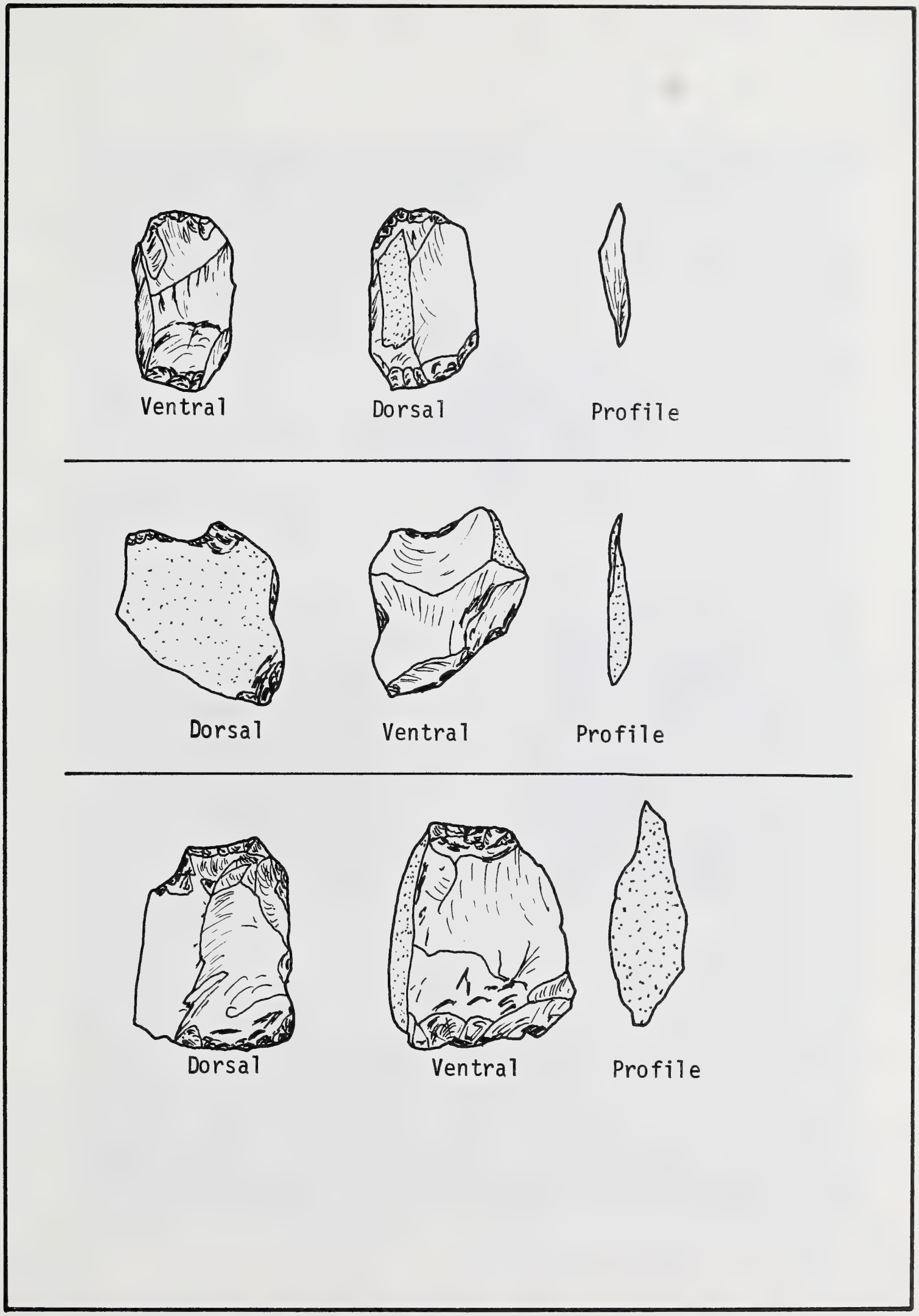


Figure 29. Pièces Esquilleés (actual size).

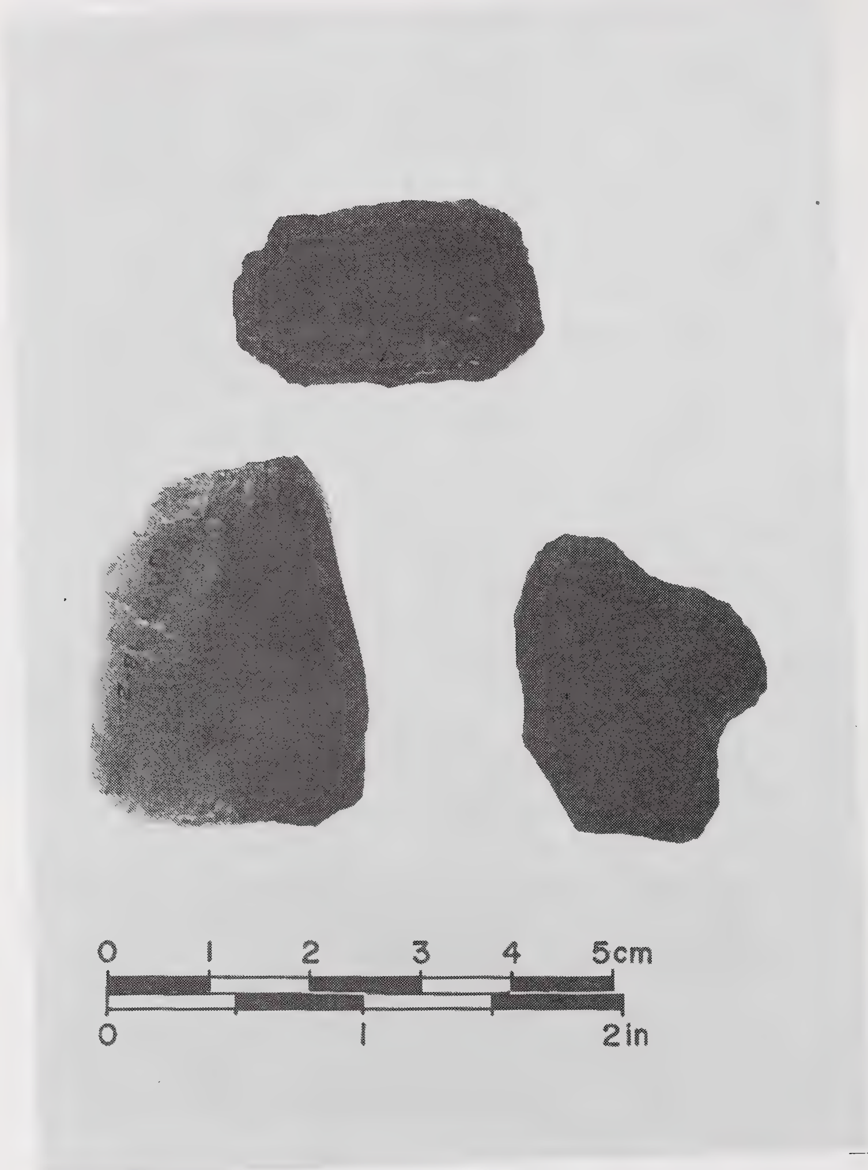


Figure 30. Pièces Esquillées.

impressions and are slightly charred. These specimens probably represent the Late Prehistoric Period and may be related to cord marked pottery that was previously recovered by Ives and Newton (1979:38). Sherds were described by Bryne as South Saskatchewan Basin Complex pottery which has an estimated temporal range of A.D. 1000 to the nineteenth century.

MISCELLANEOUS ARTIFACTS

Perhaps the most controversial object that was found during the 1980 field season is a flat object, six millimeters thick, that is shaped like the nail pulling end of a hammer (Figure 31). This object has a 0.5 mm thick clay layer on each side. After considerable searching and consultation this object was finally identified as a gray chert nodule fragment which has accidently fractured to this unusual shape (Hayden, personal communication). Comparisons to chert reference collections verified this identification.

A .22 calibre short rimfire brass cartridge case was also recovered. The cartridge head bears a 'D' (Dominion Cartridge Company). These cartridges were manufactured by the late 1800s and are still presently being used (Losey et al. 1974).

REDUCTION METHODS AND TECHNIQUES

Inferences regarding lithic reduction methods and techniques are based on the artifact and debitage analysis. Primarily, quartzite reduction is emphasized since this is the most common material at the site and is sometimes the most poorly understood.

BIPOLAR PERCUSSION

Evidently bipolar percussion was used for numerous raw materials of different sizes and shapes. Bipolar by-products were described in a preceding section, however flake types are also illustrated in Figure 32A and B. It was suggested before that this method was used primarily during the initial reduction stages for splitting large cobbles, removing spalls or flakes from cobbles, and for producing usable small flakes or blades from small pebbles that could not be fractured by any other means. Popularity of this technique is evident from recovered bipolar cores which outnumber all other core types (Table 2). However, there

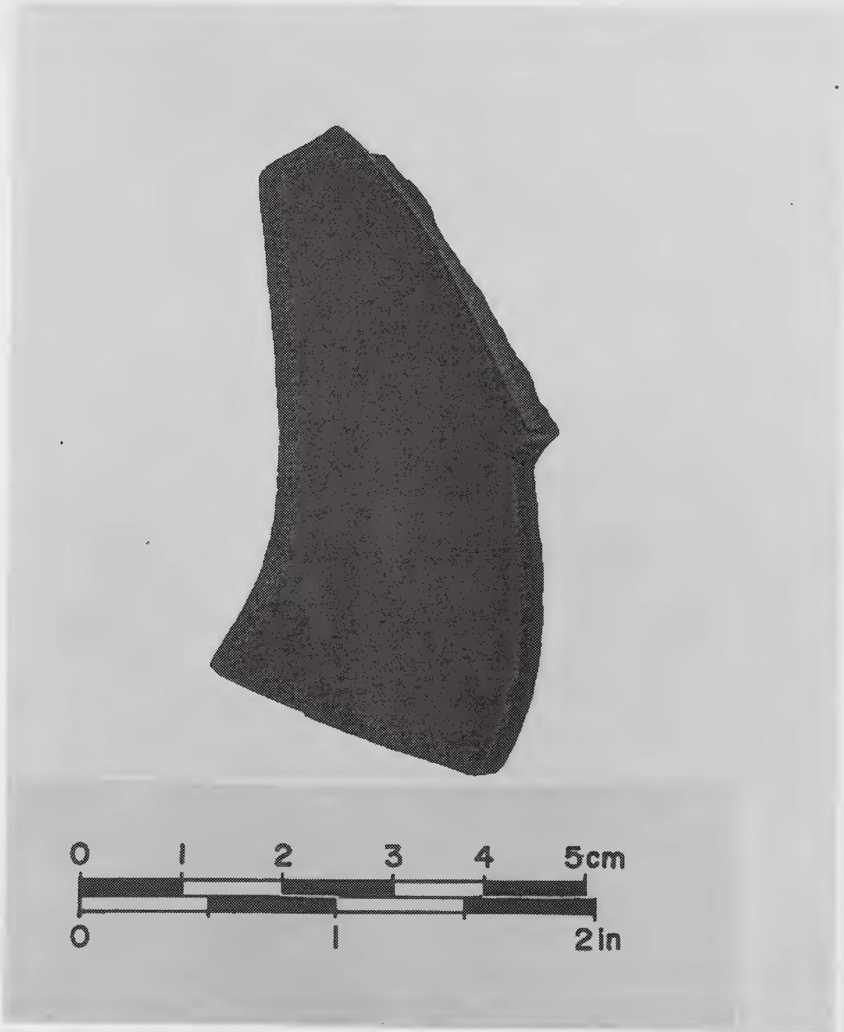


Figure 31. Chert nodule fragment.

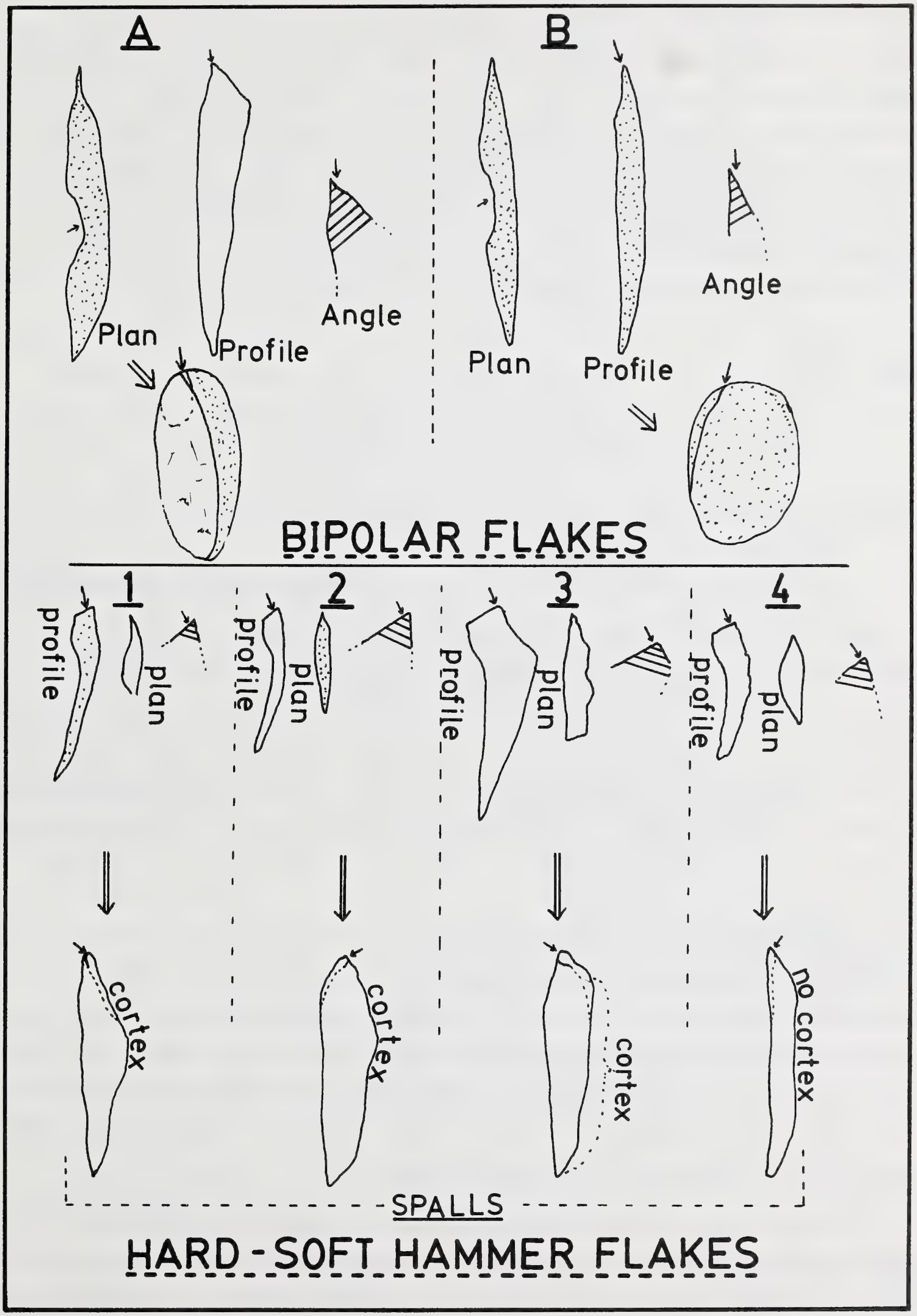


Figure 32. Illustrations of some basic bipolar flake types and hard or soft hammer flake types.

is little difference between bipolar primary decortication, bipolar secondary decortication and bipolar reduction flake ratios (Table 3). Furthermore, no major patterns are apparent when comparing bipolar flake ratios between material types (Table 3). It was expected that more vitreous materials might show higher numbers of bipolar flakes since these materials usually occur as small pebbles or nodules and must be reduced by bipolar techniques. However, curation of usable bipolar flakes and blades may be responsible for altering any significant trends.

TABLE 3

BIPOLAR FLAKE AND RAW MATERIAL RATIOS

A.	Quartzite	Petrified Wood	Chalcedony	Chert	Quartz	Mudstone
	R = .13	R = .05	R = 0	R = .04	R = 0	R = .4

B.	Primary Decortication Flakes	Secondary Decortication Flakes	Reduction Flakes
	R = .15	R = .12	R = .12

A. $R = \frac{\text{\# Bipolar Flakes}}{\text{Total Flakes (indiv. Material Type)}}$ B. $R = \frac{\text{\# Bipolar Flakes}}{\text{Total Flake types}}$

Judging from the slight differences in bipolar flake ratios, it seems that in some instances bipolar reduction was used in more than the initial reduction stage (Table 3). Certainly usable flakes or blade production would have resulted in relatively high bipolar reduction flake frequencies. Alternatively, bipolar primary decortication flakes may have been more predominant if all stages of cobble reduction or pebble splitting occurred on the upper terrace.

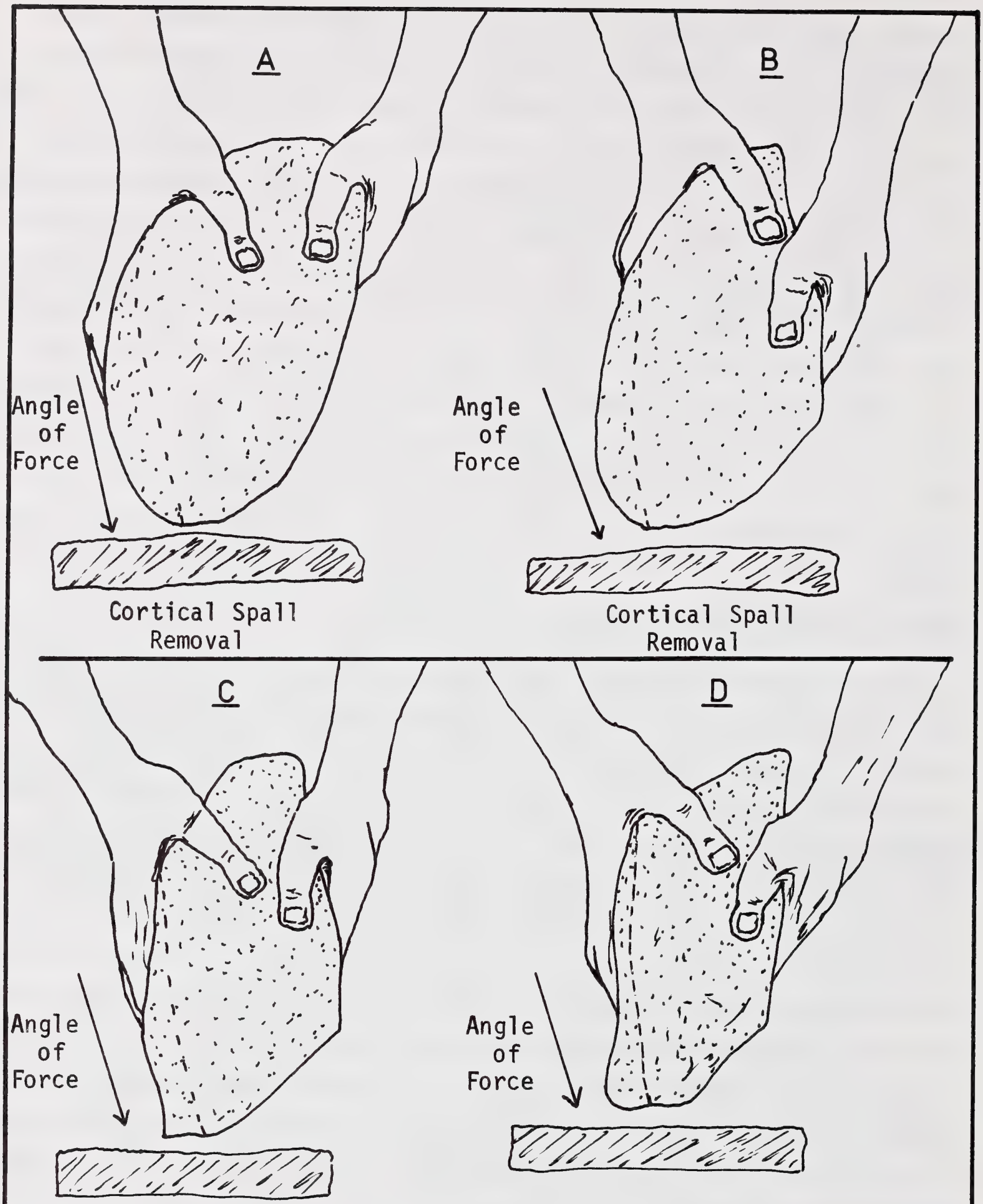
Previously, it was also argued that the degree of bipolar core reduction is not related to a need to reduce cores so they can be used as tool preforms. Instead, degree of core reduction may be related to raw material qualities and intended end products. Evidence from the bipolar core sample indicates that those cores, made from vitreous materials

such as chert, are reduced to a greater degree than quartzite cores. Furthermore, those quartzite cores which showed more reduction were originally smaller pebbles. Removal of small usable blades would require a smaller, more vitreous piece of raw material. Therefore, it seems that the degree of core reduction is related to lithic morphological drawbacks and originally intended end products. Larger, coarse-grained cobbles were most useful for removing a few large spalls or flakes. If blades or small flakes were required then larger raw material was replaced by small, vitreous pebbles which were reduced until they were exhausted. To summarize, currently, crude blade or small flake industries have not received much recognition at Alberta parkland sites. Such an attitude has led to some misunderstanding about the function and morphology of bipolar techniques and classification of the resulting bipolar by-products.

HANDHELD DIRECT PERCUSSION

It is presently difficult to determine whether a handheld direct percussion method was used at the Strathcona Site (Figure 33). With this method, a cobble is held by both hands and struck against an anvil at a specified angle (Crabtree 1972:10). This striking angle and the point of impact on the cobble is more accurately controlled than with bipolar percussion. Experiments indicate that this technique is very effective in removing at least two usable spalls from large, flat cobbles with little effort (Figure 33). Spalls are thin and flat, and thus are ideal for further artifact production. Resulting core platforms, from removal of these spalls, were at the proper angles to extract additional usable flakes by this method (Figure 33C, D). However, when further flake removal was attempted, those flakes split longitudinally down the middle of the flake. Splitting may be overcome if more vitreous heat-treated quartzite is used.

Archaeologically, this method is difficult to distinguish from bipolar percussion. Cobbles may have only one battered end if one spall is removed, or subsequent cores may resemble a parallelogram or triangle in profile if a spall is removed from each end (Figure 34A, B). Furthermore, this method also displays a point of impact on the cobble end which is slightly more off center than normally occurs with bipolar percussion.



C-D. Rotation of cobble core for removal of additional flakes.

Figure 33. Illustration of a handheld direct percussion technique and resulting flakes.

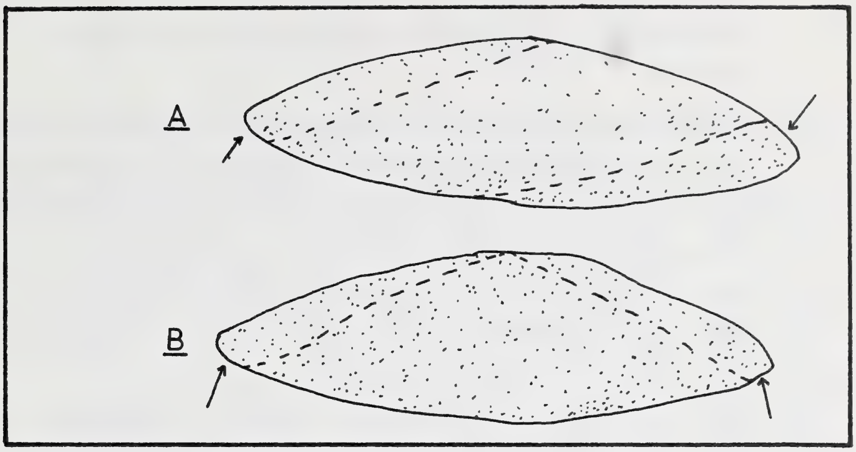


Figure 34. Removal of two spalls by handheld direct percussion resulting in a parallelogram and triangular shaped core.

Additionally, such a technique does not cause another small flake to be removed on the other side of the cobble as often happens with bipolar percussion. Examination of the Strathcona Site lithic assemblage only yielded one possible example of this reduction method. A large flake was removed from one end of a quartzite cobble that had no battering marks on the other end. Also, the fracture was located slightly off-center.

DIRECT FREEHAND PERCUSSION

Direct freehand percussion was used to detach: 1) usable spalls and flakes from cores; 2) cortex from spalls; and, 3) additional mass, to shape and thin artifacts. By-products are comprised of exhausted multiplatform cores (Figure 26A), shatter and three basic flake types that are illustrated in Figure 32. All by-products are present in the 1980 lithic assemblage (Table 2).

In preceding sections three possible spall/flake detachment techniques were described:

1. A bipolar method which will split large quartzite cobbles as well as small pebbles. Few large usable spalls can be detached by this method. Cobble halves and spalls are generally concavo-

convex in profile. Dorsal surfaces are covered with cortex, which together with other unwanted mass, is removed to thin and shape the artifact.

2. A hand-held direct percussion technique functions best when large, flat cobbles are used. This method utilizes material more efficiently than the bipolar technique. At least two cortical spalls are produced as well as additional usable flakes. Cortical spalls are also slightly concavo-convex in profile. Cortex, and additional unwanted mass, is usually removed from the dorsal surface.

3. A multiplatform core technique requires a combination of bipolar percussion and direct freehand percussion (Figure 26A). Raw material is efficiently utilized by this method which is most suitable for large, round, thick cobbles. Spall/flake morphology consists of relatively thin sections which have slightly concave ventral sides and straight dorsal faces. Cortex only occurs on proximal or distal ends in minimal quantities. Proximal ends are made slightly thicker by the bulb of percussion.

Resulting flake frequencies and the stage of reduction in which they are found will partly depend on which spall/flake removal technique is chosen. Substantially higher decortication flakes are produced when the first two techniques are used. Of course, it is presently difficult to accurately calculate flake ratios for each particular spall/flake production method without first conducting extensive lithic reduction experiments. Intuitively, and based on some preliminary reduction experiments, the following flake ratio ranges are suggested in Table 4. These ranges should account for variability in cobble and flake size. The figures clearly indicate that overall decortication flake frequencies progressively decrease from a bipolar to multiplatform spall/flake removal method, since the objective piece requires little decortication when the latter technique is used. Furthermore, a combination of the methods results in intermediate ratios which closely resemble those calculated for the second method.

Comparison of expected ratios to the 1980 lithic assemblage is presented in Table 5. Quartzite flake frequencies do not correspond to any

TABLE 4

EXPECTED PERCUSSION FLAKE FREQUENCIES AND RATIOS

Spall/Flake Reduction Method		Primary D. Flakes	Secondary D. Flakes	Reduction Flakes	Total
	Range	15 - 25	20 - 30	5 - 15	40 - 70
1.	$\bar{X}$ and R	20; .36	25; .45	10; .18	55; 1.0
	R-Ranges	.36 - .38	.43 - .50	.13 - .21	---
	Range	10 - 20	15 - 25	15 - 25	40 - 70
2.	$\bar{X}$ and R	15; .27	20; .36	20; .36	55; 1.0
	R-Ranges	.25 - .30	.36 - .38	.36 - .38	---
	Range	0 - 5	5 - 10	15 - 25	20 - 40
3.	$\bar{X}$ and R	2.5; .13	7.5; .30	20; .60	30; 1.0
	R-Ranges	.13 - 1.0	.25 - .30	.60 - .75	---
	Range	8.3 - 16.7	13.3 - 21.7	11.7 - 21.7	---
1,2,3.	$\bar{X}$ and R	13.3; .25	17.5; .37	16.7; .38	---
	R-Ranges	.25 - .56	.35 - .40	.36 - .45	---

$\bar{X}$ = Mean flake frequencies.

particular method, but more closely resemble a combination of all methods. Other raw material flake ratios are entirely different from any expected flake ratios.

TABLE 5

DIRECT PERCUSSION FLAKE RATIOS

Raw Material	Primary D. Flakes	Secondary D. Flakes	Reduction Flakes	Total
Quartzite	.20	.41	.40	959
Petrified Wood	.87	.15	.05	87
Chalcedony	.10	.10	.80	21
Chert	.15	.11	.74	27
Quartz	--	--	1.0	3
Mudstone	.33	.30	.40	15

$$R = \frac{\text{Flake type}}{\text{Total flake types}}$$

It is presently difficult to isolate the main reasons for discrepancies

between expected and actual flake ratios. At least three possibilities for these differences exist:

1. The lithic assemblage ratios represent the correct relative proportions for a particular method, but differ from expected ratios which are incorrect.

2. Some stages of spall/flake detachment were carried out elsewhere (ie. on lower river terraces). Thus, decortication flake ratios occur in lower than expected frequencies.

3. A combination of all three methods was used at the Strathcona Site, which results in ratios that do not correspond to any particular set of ratios.

It seems that all spall/flake removal techniques were used. First, ratios more closely resemble the combined ratios in Table 5. Secondly, if a multiplatform core spall/flake removal method was solely used then the reduction flake ratios should be considerably higher than they are. Also, various core types were recovered, although bipolar cores were predominant. Finally, completed blank-biface attributes indicate that all three methods were used. However, these preliminary quantities suggest that concavo-convex spalls, with cortex on the dorsal face, were being selected for. Therefore, the bipolar and hand-held spall/flake removal methods seem to have been more commonly used. Such inferences can only conclusively be demonstrated when additional cobble reduction experiments are carried out to generate data on flake type ratios.

Examination of various flake types also suggests that all spall/flake detachment methods were used. Initial spall decortication is evident from primary decortication flakes that have cortex only on the dorsal surface. Few primary decortication flakes were recovered that have cortex on the platform and dorsal surface. Such flakes are formed when whole cobbles are reduced by freehand percussion. The initial flakes that are removed from these cobbles will have cortex on the platform as well as dorsal face.

Secondary decortication flakes were separated into two types. The first type is a platform rejuvenation flake which is removed from the ventral surface of the artifact before any cortex is removed from the

dorsal surface (Figure 32, 35). Only the proximal end or platform of the ventral surface of the flake has cortex on it. This flake is formed when the line of gravity of the artifact is moved closer to the center enabling the worker to effectively remove dorsal cortex in the next reduction stage (Figure 35). The second flake type is intended to remove cortex from the dorsal side of the artifact (Figure 35B, C). This flake (dorsally) has cortex nearer the center or distal end and is formed when the worker nears the finished blank-biface. Subsequently, only the distal end of the flake will catch any remaining cortex left on the artifact (Figure 35B, C).

Reduction flakes represent the last percussion reduction stages of blank-biface production. Two types were recovered. The first type is removed from the ventral side of the artifact after some dorsal cortex is already detached (Figure 35E, F). If the ventral side is flat or concave from being sheared, then the dorsal side of the flake will usually be quite flat with few other flake scars present. The second type of reduction flake is removed from the dorsal face where many decortication flakes have already been removed. Thus, the flake dorsal surface is often heavily scarred by other flake ridges. These two reduction flake types are often difficult to distinguish in the lithic assemblage.

PRESSURE FLAKING

Attempting to examine the final lithic reduction stages is often difficult since pressure flakes are sometimes indistinguishable from reduction flakes (Jelinek 1965:279). The majority of 'retouch' flakes are pressure flakes since they possess the previously mentioned attributes (Table 2). As well, many of these flakes are so small (between 3.0 mm and 15 mm) that it would be impossible to remove them by any other reduction technique.

Pressure flakes occurred in relatively high frequencies and were made from all local raw materials (Table 2). These results, in conjunction with recovered pressure flaked artifacts, indicate that artifacts were finished at the site more often than was previously thought (Newton and Pollock 1979). Even coarse-grained materials, such as quartzite, were pressure flaked. Presumably pressure flakes should occur in lower

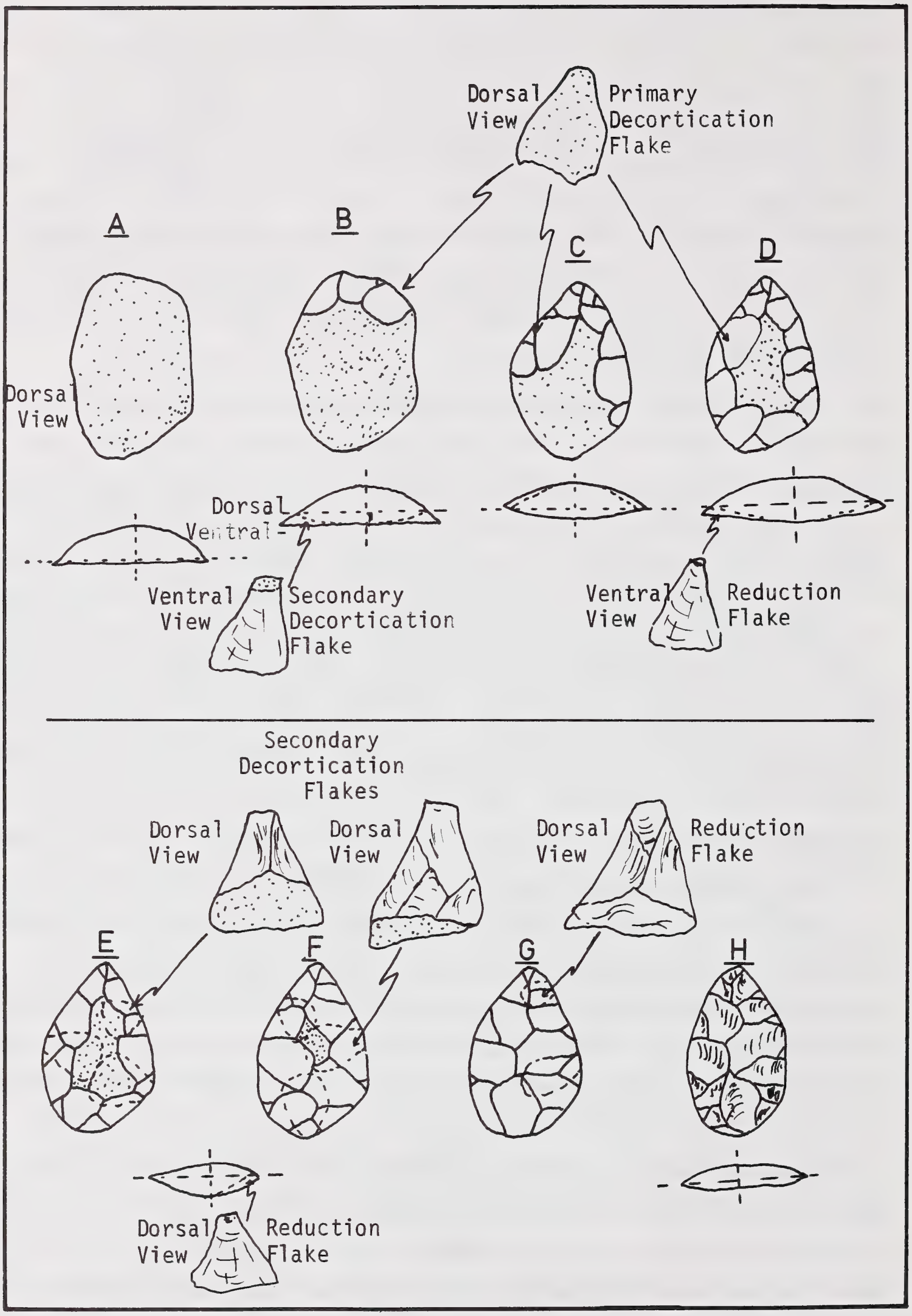


Figure 35. Illustration of spall reduction, blank-biface production and resulting flake types. Adapted after Callahan (1979).

frequencies because of their small size. Results from a five percent bulk sample analysis indicates that only five retouch flakes were smaller than the screen mesh that was used (Appendix V). Therefore, an estimated 100 pressure flakes were missed during the 1980 field season. Such a correction factor is important when various flake type frequencies are compared. However, results from a comparison of various raw material pressure flake relative proportions should not be significantly altered since it is assumed that flake loss occurred equally among all material types. Calculated pressure flake relative proportions show that those materials which are the most vitreous generally have the highest ratios (Table 6). This suggests that more silicious materials were selected for small tool production, or, coarser-grained artifacts, such as quartzite, were not entirely completed at the site. At this time the former inference is more acceptable since there presently exists no sound reason why the other raw materials should be more completely reduced at the site.

TABLE 6

RELATIVE PROPORTIONS OF PRESSURE FLAKES

Material Type	Quartzite	Petrified Wood	Chal-cedony	Chert	Quartz	Mud-stone
Pressure Flakes	275	2	18	7	6	8
Total Flakes	1375	94	41	35	9	33
Ratio	.20	.02	.44	.20	.67	.24

INTRA-SITE AND INTER-SITE COMPARISONS

TEMPORAL TECHNOLOGICAL TRENDS

Prehistoric culture change took place throughout the Middle and Late Prehistoric Periods in north-central Alberta. Such change should also be reflected in lithic assemblages recovered from prehistoric workshops. However, it is difficult to establish how, and to what degree, culture change affects basic extractive and reduction techniques. This task becomes even more arduous since the majority of the lithic assemblage consists of artifact by-products, or debitage. Certainly by-products are the negative image of finished artifacts, but currently little research has been conducted to thoroughly investigate what diagnostic lithic attributes will document various artifact types or change. Furthermore, a lack of sound stratigraphic control also encumbers such a comparison. Thus, only relative temporal lithic comparisons can be carried out here to measure temporal technological change.

A brief review of Alberta prehistory indicates that the following technological changes occurred between the Middle and Late Prehistoric Periods:

- introduction of the atlatl, and later the bow and arrow, led to greater use of smaller projectile points.
- introduction of large game encircling activities.
- introduction of tipis and pottery.

Generally, empirical evidence also shows that throughout prehistory man constantly attempts to refine his lithic technological reduction and production methods. Subsequently, less energy is expended on subsistence activities and available resources are utilized more efficiently. Therefore, possible archaeological evidence for temporal technological change may include:

A. A multiplatform core reduction technique and blade removal technique will utilize local raw materials more efficiently.

   - multiplatform and blade core frequencies will increase temporally.

- reduction flakes increase temporally.

- decortication flakes decrease temporally.

B. Introduction of smaller projectile points may have resulted in a change in raw material use. There exist some physical restraints in raw material size. For example, larger tools and point types could only be made from larger raw materials, such as quartzite. An increase in the use of smaller projectile points removed these physical restraints which also resulted in an increased use of better quality raw materials (ie. chert, chalcedony, petrified wood or mudstone) (Figure 36):

- smaller, more vitreous materials increase temporally.

- smaller, more vitreous bipolar core frequencies should increase temporally.

- pressure flakes and bipolar flakes should increase temporally.

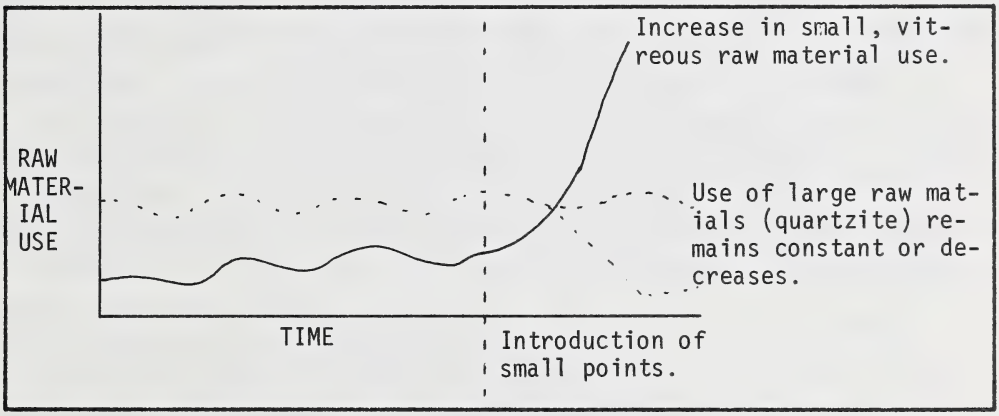


Figure 36. Introduction and use of smaller projectile points alleviates raw material size restraints, resulting in greater use of silicious, smaller raw materials.

C. Woodworking activities increased temporally when the atlatl, bow and arrow and large game pounding corrals were introduced:

- smaller woodworking tool frequencies increase.

- heavy chopping tools, for felling larger trees, increase temporally. Ground stone tools are introduced since they are

more efficient and last much longer when cutting wood (Hayden 1977).

TEMPORAL MEASUREMENTS

Results from the previous lithic analysis indicated that a variety of reduction methods were more or less equally employed at the Strathcona Site. However, it was also cautioned that some trends may have been masked when materials from a long temporal span were combined. The following analysis examines whether technological lithic variability was indeed masked by such temporal grouping.

Data from Units 2, 3 and 4 were omitted. This area was badly disturbed by heavy equipment. Also, these units were previously partially excavated. Subsequently, unit arbitrary levels were not comparable to other unit levels.

The lithic assemblage was divided into three arbitrary temporal levels: 1) 10 cm levels; 2) 20 cm levels; and, 3) 30 cm levels. Some quantitative error will undoubtedly occur from such divisions since technological change is dynamic and may span more than one arbitrary level. Also, it is questionable which arbitrary arithmetic range best measures temporal lithic change, if it exists. Too many arbitrary divisions will result in a great deal of detail, which can obscure any major patterns. On the other hand, too few divisions often smooths over lithic quantitative changes. Results from all three divisions were computed and are considered in the following analysis.

Lithic relative frequencies within each arbirary level were calculated in order that data from each arbitrary level could be compared. This method ensured that changes in artifact frequencies in a particular level were not caused by overall quantitative changes.

Lithic categories were examined graphically and Pearson Correlation Coefficients were computed for each category (Gilbert 1976; Thomas 1976). All raw data is presented in Appendix VI. Correlation coefficient values can effectively determine whether any relationship between variables exists and whether these relationships were variable or relatively uniform temporally. Linear regression equations were not computed since the sample is presently relatively small and incomplete.

A. TESTING LITHIC REDUCTION TEMPORAL VARIABILITY

All quantitative results are presented in Table 7. It is immediately apparent that lithic frequencies gradually increase towards the upper arbitrary levels. Such an increase may have been caused by an intensity of activities, or an increase in group sizes at the site. However, artifact relative frequencies do not entirely conform to this pattern. Multiplatform core relative frequencies do not significantly increase in the later periods. Bipolar core relative frequencies do not become smaller in the upper levels. Quartzite reduction flake relative frequencies show no substantial increase in the upper levels. Furthermore, decortication flake proportions do not decline appreciably in upper levels, as would be expected if reduction techniques changed greatly.

Core and flake type frequency comparisons from each arbitrary level are presented in Figure 37. Only the 'multiplatform core--bipolar core' correlation coefficient was beneath the acceptable confidence level. However, correlation coefficients between various other flake types are very high (Figure 37). Therefore, flake types covary temporally, or, an increased use of one flake type also resulted in an increase in the other flake type. Thus, flake type ratios remain temporally constant.

To summarize, presently the foregoing results refute previous suggestions that lithic reduction techniques change significantly temporally. The tested variables are generally temporally constant, indicating that a combination of reduction methods were used throughout the Middle and Late Prehistoric Periods.

B. TESTING RAW MATERIAL TEMPORAL VARIABILITY

Results from testing raw material temporal variability, are presented in Table 8. All lithic categories also gradually increase towards the upper levels. Relative frequencies for vitreous materials, bipolar cores and pressure flakes do not significantly increase towards the upper levels. Petrified wood relative proportions do not increase in the upper levels, nor does quartzite decrease towards the upper levels.

These variables were graphically compared and correlation coefficients were computed (Figure 38). Most R-values were extremely high with the exception of the 'quartzite flake--total flake' and 'vitreous

TABLE 7

QUARTZITE CORE AND FLAKE TEMPORAL DISTRIBUTIONS

	Levels	A	B	C	D	E	F	Total
Multi-platform Cores	-	4	1	4	3	-	-	12
	Total	9	3	11	5	2	-	30
	R.	.44	.33	.36	.60	-	-	-
	R.	A + B = .42		C + D = .44		E + F = 0.0		-
		A + B + C = .39			D + E + F = .43			-
Bipolar Cores	-	5	2	7	2	2	-	18
	Total	9	3	11	5	2	-	30
	R.	.56	.67	.64	.40	1.0	-	-
	R.	A + B = .58		C + D = .56		E + F = 1.0		-
	R.	A + B + C = .61			D + E + F = .57			-
Decortication Flakes	-	109	244	130	20	8	9	520
	Total	169	386	204	33	23	14	829
	R.	.64	.63	.64	.61	.35	.64	-
	R.	A + B = .64		C + D = .63		E + F = .46		-
	R.	A + B + C = .64			D + E + F = .53			-
Reduction Flakes	-	70	145	75	14	13	5	322
	Total	169	386	204	33	23	14	829
	R.	.41	.38	.37	.42	.57	.36	-
	R.	A + B = .39		C + D = .38		E + F = .49		-
	R.	A + B + C = .38			D + E + F = .46			-

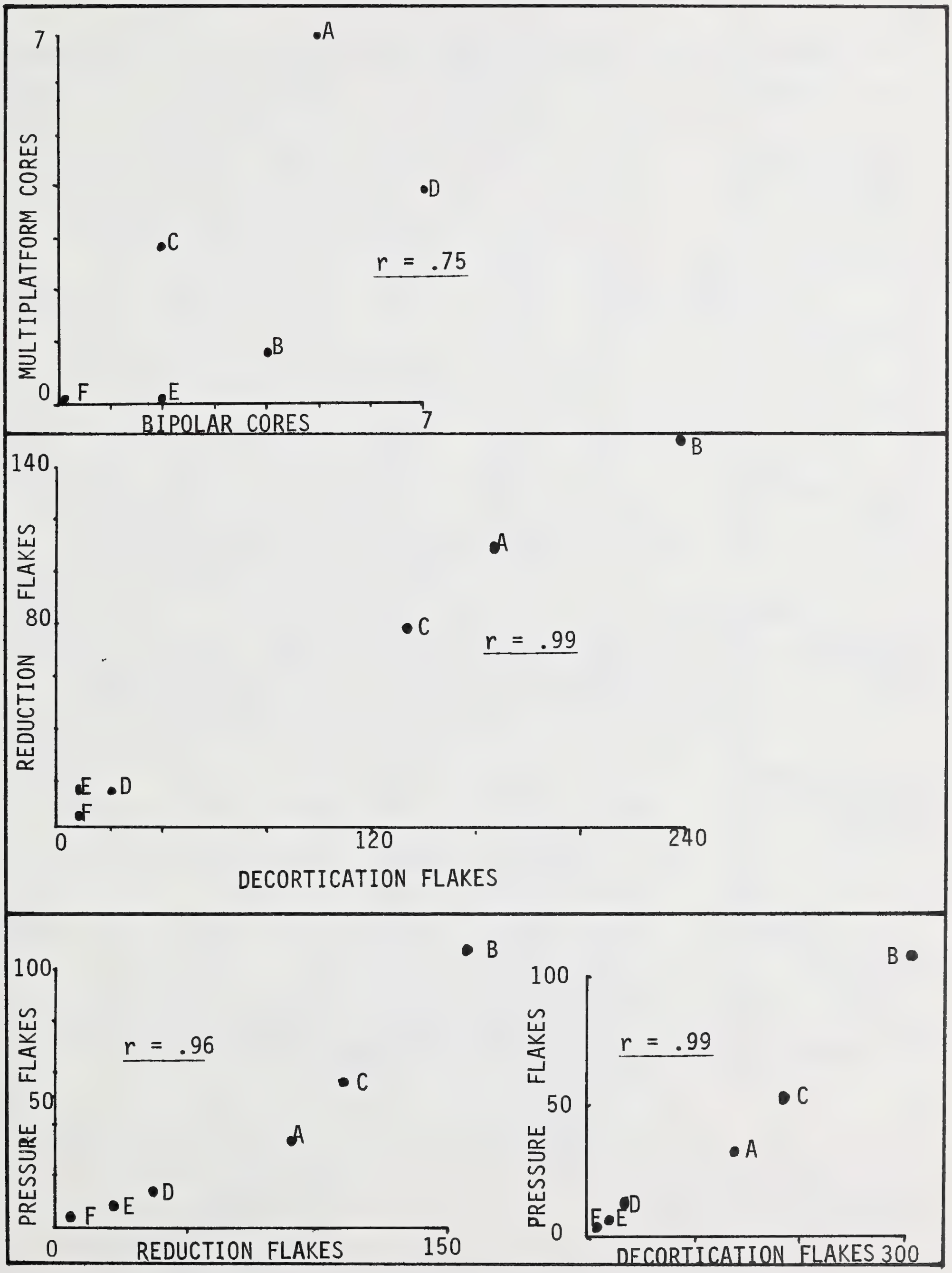


Figure 37. Comparisons of core and flake type frequencies.

TABLE 8

MATERIAL AND ARTIFACT TEMPORAL DISTRIBUTIONS

Levels		A	B	C	D	E	F	Total
Vitreous Materials	-	27	63	45	12	6	1	154
	Total	944	2161	1502	281	128	65	5081
	R	.03	.03	.03	.04	.05	.02	-
	R	A + B = .03		C + D = .03		E + F = .04		-
	R		A + B + C = .03			D + E + F = .04		-
Quartzite	-	672	1619	1068	205	97	52	3713
	Total	944	2161	1502	281	128	65	5081
	R	.71	.75	.71	.73	.73	.76	-
	R	A + B = .74		C + D = .71		E + F = .77		-
	R		A + B + C = .73			D + E + F = .74		-
Petrified Wood	-	209	523	226	41	19	11	1029
	Total	944	2161	1502	281	128	65	5081
	R	.22	.24	.15	.16	.15	.17	-
	R	A + B = .24		C + D = .15		E + F = .16		-
	R		A + B + C = .21			D + E + F = .15		-
Vitreous Bipolar Cores	-	2	1	5	1	-	-	9
	Total	12	5	10	5	2	-	35
	R	.17	.20	.50	.20	0.0	0.0	-
	R	A + B = .18		C + D = .40		E + F = 0.0		-
	R		A + B + C = .30			D + E + F = .14		
Vitreous Pressure Flakes	-	8	11	11	4	3	1	37
	Total	18	47	23	10	6	1	105
	R	.44	.23	.48	.40	.50	1.0	-
	R	A + B = .29		C + D = .45		E + F = .57		-
	R		A + B + C = .34			D + E + F = .47		-
Quartzite Pressure Flakes	-	27	112	61	12	6	6	224
	Total	188	197	265	45	29	20	744
	R	.14	.57	.23	.27	.21	.30	-
	R	A + B = .36		C + D = .24		E + F = .24		-
	R		A + B + C = .31			D + E + F = .25		-

Vitreous Materials = (chalcedony, chert, quartz and mudstone).

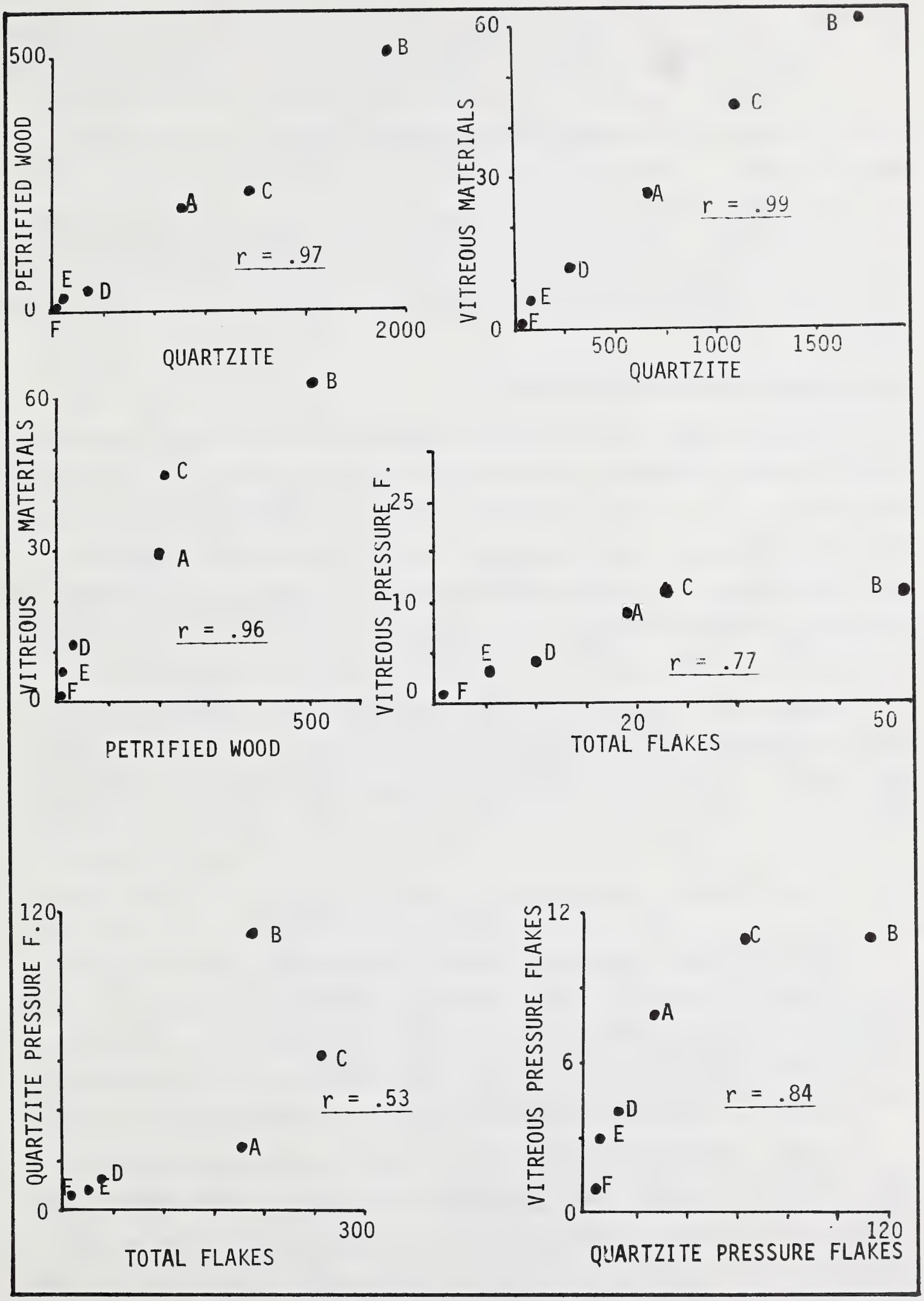


Figure 38. Comparison of materials and flake type frequencies.

pressure flake--total flake' categories which had values that fell below the acceptable critical levels. Again, such results indicate that these variables covary temporally. In other words, these variables maintain similar ratios in all levels which suggests temporal homgeneity of raw material use.

To summarize, results did not conform to the previously postulated inferences that an increased use of vitreous raw materials, bipolar cores or pressure flakes would result in the upper segment of the lithic assemblage.

C. WOODWORKING TEMPORAL VARIABILITY

Currently, there exists little quantitative data to test this postulation. End scrapers and side scrapers occur in relatively minimum numbers but all were recovered in the upper 30 cm. However, scrapers may also have been used for other activities. No ground stone implements were recovered in the 1980 lithic assemblage. However, one specimen was previously recovered at the site. Presently, the provenience of this artifact is unknown.

To summarize, the above results are inconclusive and must await a larger sample before they can be adequately tested. Furthermore, use wear analysis on scrapers may help determine the function of these artifacts.

ON-SITE VERSUS OFF-SITE ACTIVITIES

Lithic material, recovered from the site boundary transect survey, was compared to the site lithic sample to determine what stages of lithic reduction occurred on lower and upper terraces. Presently, the lower terrace sample is relatively small. Consequently, the following preliminary results should be re-examined with a larger sample.

The mere presence of lithic material on lower terraces, as well as upper terraces, suggests that reduction took place in both areas. Such a combination of events seem likely since a great deal of energy was required to carry heavy raw materials up the steep river terraces. However, whole quartzite cobbles may have been carried to camp for eventual heat treatment. Admittedly, this task could have taken place on lower

terraces, but more likely occurred at camps since it was a relatively lengthy process. Other, more vitreous raw materials were smaller and lighter and presumably were entirely reduced at the camp site.

A total of six artifact and debitage categories were chosen to more thoroughly investigate any possible spatial patterns in the lithic reduction sequence. Cores, spalls and the various flake types which represent the entire reduction sequence were selected. This sample was also divided into 'quartzite' and 'vitreous' material classes. It was felt that these materials may have been reduced to various stages at different areas because of their considerable size differences. Also, it has already been established that all reduction stages and methods occurred at the site over a long temporal period. Thus, these variables will minimally affect any observed artifact frequencies which differ from expected frequencies in both classes.

A comparison of the artifact frequencies from the upper and lower terraces is presented in Table 9. A chi-square test was computed for quartzite artifacts to determine to what extent expected frequencies differed from observed frequencies (Table 9). Generally, such an analysis also examines whether there is a relationship between certain artifact types and area. The results indicate that there are some major discrepancies between expected and actual frequencies (Table 9). Upon closer examination, those artifacts that deviated significantly from expected frequencies consisted of quartzite primary decortication flakes and cores which occur in higher than expected frequencies on lower terraces (Table 9). Moreover, secondary reduction frequencies were slightly lower than expected on lower terraces (Table 9). Quartzite artifact frequencies from the upper terraces were generally similar to expected frequencies. Nevertheless, it seems that initial quartzite reduction took place more frequently than expected on lower terraces while frequencies were slightly less than expected from the latter part of the reduction sequence.

Attempts were made to carry out a similar comparison with the 'vitreous' material. However, the sample from the lower terrace is proportionally smaller when compared to quartzite artifacts which indicates that these materials were reduced less often on lower terraces. Furthermore, when relative frequencies of 'quartzite' to 'vitreous' materials

TABLE 9

COMPARISON OF INITIAL TO SECONDARY REDUCTION SEQUENCES BY AREA

	LOWER TERRACES		UPPER TERRACES		
	O	E	O	E	
Cores	6	1	0	45	46
Primary Decortication Flakes	10	4.9	230	235.1	240
Secondary Decortication Flakes	7	9.3	443	440.7	450
Reduction Flakes	4	8.9	427	422.1	431
Retouch Flakes	-	5.7	275	269.3	275
Spalls	3	0.2	11	13.7	14
	30		1426		1456

		Observed	Expected	$(O - E)^2/E$
L. TERRACES	Cores	6	1	25.0
	Primary Decortication Flakes	10	4.9	5.3
	Second. Decortication Flakes	7	9.3	0.55
	Reduction Flakes	4	8.9	2.7
	Retouch Flakes	-	5.7	5.7
	Spalls	3	2	0.5
U. TERRACES	Cores	40	45	0.56
	Primary Decortication Flakes	230	235.1	0.11
	Second. Decortication Flakes	443	440.7	0.01
	Reduction Flakes	427	422.1	0.06
	Retouch Flakes	275	269.3	0.12
	Spalls	11	13.7	0.53
				$41.16 = X^2$

$D = 5$; D_5 at 95% = 11.1

H_o: There is no significant relationship between artifact type and area.
H_1: There is a significant relationship between artifact type and area.
Reject H_o.

are compared using the site sample it is quite apparent that primary decortication flakes occur in higher frequencies in the latter material class (Table 10). The 'vitreous' to 'quartzite' artifact relative frequencies were also graphically compared and a Pearson Correlation Coefficient was computed (Figure 39; Appendix VI). A very weak linear relationship was evident and a low correlation R-value was computed. Primary decortication flake frequencies are mainly responsible for this low value. The weak relationship between artifact frequencies from these two raw materials could be due to differences in on-site versus off-site lithic reduction. This suggestion, however, is tentative since such deviations may be mainly due to use of different reduction techniques.

TABLE 10

COMPARISON OF INTITAL TO SECONDARY REDUCTION SEQUENCES BY AREA

Artifacts		Cores	Primary D. Flakes	S. D. Flakes	. Red. Flakes	Ret. Flakes	Spalls	Total
Vitreous Materials	T	29	88	25	58	41	-	241
	R	.42	.42	.12	.28	.20	0.0	
Quartzite Materials	R	.43	.17	.32	.31	.20	1.0	-
	T	40	230	443	427	275	11	1426

It should be re-emphasized that the foregoing results may have been biased by a relatively small lower terrace lithic sample, as well as by differences in excavation and recovery methods between the two areas. Such methods would invariably affect small artifact frequencies (ie. retouch flakes). But even when retouch flakes are removed there are still major differences between expected and observed frequencies in the chi-square analysis.

PREHISTORIC QUARRY/WORKSHOPS: DEFINITION AND COMPARISON

DEFINITION

Prehistoric quarry/workshops form the basis for lithic resource

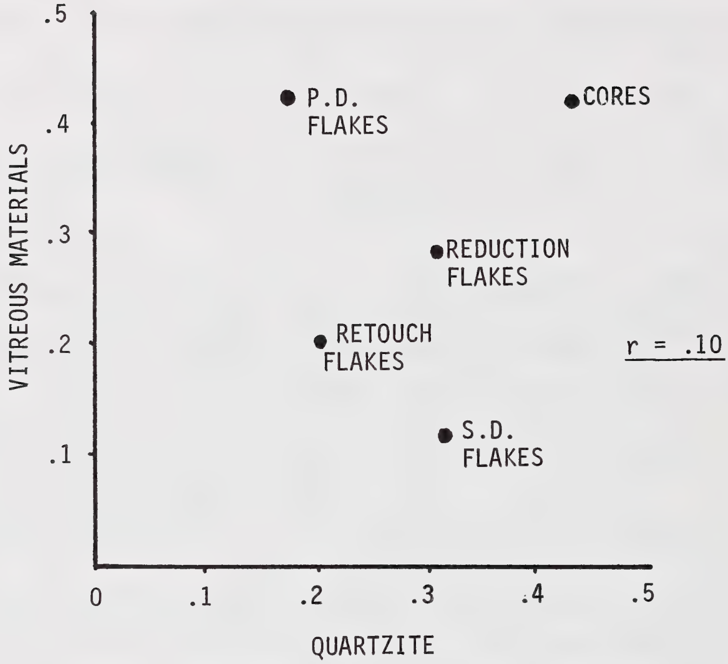


Figure 39. Comparison of 'Vitreous' to 'Quartzite' artifact and debitage types.

procurement strategies and subsequent aboriginal settlement patterns. Such sites should differ from other sites geographically, as well as by their respective lithic assemblages. Generally, major differences should be reflected in assemblage and raw material frequency or diversity.

Lithic materials become part of the archaeological record when they are discarded as refuse or when they are misplaced (Schiffer 1972). The length and intensity of site occupation proportionally increases the probability of misplacing or discarding an item. Thus, special function sites, such quarry/workshops, should contain few artifacts and minimal artifact diversity since the major purpose of such sites was to produce artifacts for future use. On the other hand, artifact frequency and diversity should significantly increase at more permanent habitation sites where these items are used, worn out and finally discarded.

Data show that initial and secondary lithic reduction stages took place at quarry/workshops. Primary and secondary decortication flakes should occur more frequently than at regionally related habitation sites. Also, bipolar percussion takes place mainly during the initial reduction stages. Therefore, far more bipolar flakes should be present at quarry/workshops than at other sites. Pressure flakes were initially removed to shape, thin and eventually to resharpen tools. Thus, pressure flakes should be found at quarry/workshops, if artifacts were completed there, but these flakes should be present at habitation sites where final tool completion and maintenance took place.

Exhausted cores and hammerstones should be relatively more frequent at quarry/workshops than at habitation sites. If quarry/workshops functioned to produce usable flakes or blades for immediate or future use, then more exhausted cores should occur at the site and surrounding area. Generally, hard hammer percussion is used in the initial reduction stage. Hammerstones should therefore occur more frequently at quarry/workshops, unless they were curated or destroyed by use. Finally, quarry/workshops should contain fewer artifacts that are made from exotic raw materials.

COMPARISONS

The Strathcona lithic assemblage was compared to the Prosser Site (Heitzman 1979) and the Stony Plain Site assemblages (Losey 1971). The

former site is described as a 'workshop-campsite' (Heitzman 1979:20), while the latter site supposedly resemble the Strathcona Site both geographically and functionally.

It was assumed that any marked differences between quarry/workshops and more permanent habitation sites should be most apparent in the those attributes that were described in the previous section. Some categories were not directly comparable to other lithic assemblages and thus are omitted in the analysis. A more detailed comparison to the Prosser Site than to the Stony Plain Site assemblage was possible.

There are significant differences in hard hammer flake frequencies and various flake relative proportions between the Strathcona and Prosser assemblages (Table 11A). Relatively higher percentages of decortication flakes are present at FjPi-29 while higher amounts of reduction and retouch flakes are evident at the Prosser Site. Cores and spalls also occurred in slightly higher proportions at the Strathcona Site. No significant differences in artifact frequency and diversity was apparent between the two lithic samples.

All three sites were compared using only five lithic categories (Table 11B). The results are surprising since some major differences between the Stony Plain and Strathcona lithic assemblage occur, especially the decortication flakes which occur only in minimal frequencies at the former site. Also, artifact frequency relative proportions are significantly higher at the Stony Plain Site.

It is presently difficult to assess the degree of difference between the three lithic assemblages. A contingency table was computed and indicates that the sum of all artifact category differences between the expected and observed classes are greater between the Strathcona Site and Stony Plain Site, whereas FjPi-29 and the Prosser Site have roughly similar sums (Table 12). These results suggest that a great deal of similar activities may have occurred at the latter two sites, or there may be regional similarities in lithic procurement systems. However, major differences may simply be due to comparable quantitative difficulties. Currently, it is difficult to establish which factor(s) are responsible for these discrepancies.

TABLE 11

COMPARISON OF SITE LITHIC ASSEMBLAGES

A.

Artifact Type	STRATHCONA #	STRATHCONA R	PROSSER #	PROSSER R
Artifact Freq.	54	.03	27	.02
Artifact Div.	8	.004	7	.004
Cores	69	.04	16	.01
Hard Hammers	40	.02	-	0
Prim. Decor. F.	325	.18	137	.09
Secon. D. Flake	469	.26	118	.08
Reduction F.	492	.28	672	.43
Retouch F.	317	.18	578	.37
Spalls	11	.006	2	.001
Total	1785		1557	

B.

Artifact Type	STRATHCONA #	STRATHCONA R	PROSSER #	PROSSER R	STONY PLAIN #	STONY PLAIN R
Artifact Freq.	54	.03	27	.02	124	.27
Artifact Div.	8	.005	7	.004	6	.01
Cores	69	.04	16	.01	31	.07
Decort. Flakes	794	.46	255	.16	50	.11
Other Flakes	809	.47	1250	.76	244	.54
Total	1734		1645		455	

$$R = \frac{\text{Artifact Frequency}}{\text{Total Artifacts}}$$

TABLE 12

DIFFERENCES BETWEEN SITE LITHIC ASSEMBLAGES

	STRATH		PROSSER		S. PLAIN		
	O.	E.	O.	E.	O.	E.	
Artifact Freq.	54	92.7	27	88.0	124	24.3	205
Artifact Div.	8	9.5	7	9.0	6	2.5	21
Cores	69	52.5	16	49.8	31	13.8	116
Decort. Flakes	794	497	255	471.5	50	130.4	1099
Other Flakes	809	1041	1250	988.1	244	273.3	2303
Total	1734		1645		455		3834

$$E = \frac{\text{Col. Total x Row Total}}{\text{Grand Total}}$$

	Artifacts	0	E	$(0 - E)^2/E$
STRATH	Artifact Freq.	54	92.7	16.1
	Artifact Div.	8	9.5	0.2
	Cores	69	52.5	5.2
	Decort. Flakes	794	497	177.5
	Other Flakes	809	1041.6	51.9
				Σ250.9
PROSSER	Artifact Freq.	27	88	44.3
	Artifact Div.	7	9	0.4
	Cores	16	49.8	22.9
	Decort. Flakes	255	471.5	99.4
	Other Flakes	1250	988.1	69.4
				Σ236.44
S. PLAIN	Artifact Freq.	124	24.3	409.1
	Artifact Div.	6	2.5	4.9
	Cores	31	13.8	21.4
	Decort. Flakes	50	130.4	49.6
	Other Flakes	244	273.3	3.1
				Σ488.1

SUMMARY AND CONCLUSIONS

Archaeological investigations at the Strathcona Site were designed to inform the public about Alberta prehistory and to establish greater consistency in future fieldwork analysis. The lithic analysis generated preliminary descriptive, analytical and typological data on prehistoric lithic technologies and resource extractive systems. A brief summary of these results and some conclusions are presented here in hopes that some consensus can be reached on what direction future excavations and analysis should take at the Strathcona Science Park Site.

FIELDWORK

During the past field season all previously unfinished units were completed. A permanent grid system was installed and should result in accurate, easy placement of all future excavation units. This grid system, along with the detailed contour map, will also be useful when a more systematic sampling design is incorporated on both the upper and lower terraces of the site. The bulk sample fine-sorting analysis shows that smaller artifact loss was minimal.

Examination of Gibson's (1979) proton magnetometer anomalies indicates that use of such instruments in archaeological field surveys must be reassessed and improved in the future. There are currently too many other variables, besides hearths, that will cause high magnetic readings. It is entirely possible that a larger excavated area around the anomaly is required to locate hearths. However, if hearths are located greater distances from recorded anomalies, then the overall advantage of using such techniques becomes somewhat questionable. Also, in the future a more rigorous search for surface metal objects in anomaly areas must be undertaken before any excavation begins. Such precautionary measures will save both time and energy in the future.

Comparison of the mean cultural depositional rate to temporally diagnostic artifacts shows that there is only a very rough correlation between the two variables. Presently, the large temporal artifact range makes it difficult to even spatially separate artifacts in groups as large as major cultural complexes. At best, the lithic assemblage can be

treated as a temporal continuum which should be excavated in arbitrary levels that are sufficiently sensitive to maintain the necessary vertical control. Such a method involves some error but should be accurate enough to identify prehistoric technological change, if it exists. In the future, as more temporally diagnostic artifacts are recovered, greater consistency or stratigraphic patterns may emerge. If this goal can be accomplished then the level and width of arbitrary levels can be recalibrated to conform to those distinctive cultural depositional ranges.

Results from unit two-dimensional artifact plots also supports the fact that distinct stratigraphic separation is not presently possible at the site. Few discrete artifact separations were apparent even when local topographical variables are minimized. However, in those units where cultural deposition was deeper, some distinct breaks occur in the sequence. Consequently, in the future more careful investigation of these areas may result in at least some gross lithic assemblage separations. Stratigraphic control is further hampered by frost heaving activities which are apparent from artifact fragments that are located 10 cm apart vertically, but fit together. Therefore, any potential cultural stratigraphic control that might have previously existed, was obscured by frost action which filled in those portions of the profile that initially contained none or few artifacts. Furthermore, if the site was annually or at least quite often visited throughout the Middle and Late Prehistoric Periods then the assemblage can be regarded as a cultural continuum which can be arbitrarily sampled to document lithic technological changes.

A preliminary boundary and area survey verified that cultural activity took place on lower terraces. Presence of a relatively large faunal concentration south of the site will require futher examination. Certainly cultural activity was not nearly as intense as on the upper terrace. The study indicates that artifact frequencies decrease rapidly towards lower terraces and seem to be more frequent on the southern side of the site. Such a pattern has important implications for the future incorporation of a sampling design for the entire area.

To conclude, the 1980 fieldwork successfully accomplished the initial research objectives that were set out prior to the beginning of the

field season. As with most research, additional problems were revealed by excavations and must be investigated in the future.

LITHIC ANALYSIS

Lithic description, classification and quantification has provided data and insight on regional culture history, lithic reduction techniques, temporal lithic technological trends and insight on regional prehistoric resource utilization.

CULTURE HISTORY

Lithic quarry/workshops form an intregal part of aboriginal resource utilization and thus are very reliable indicators of regional culture history over a long continuous temporal span. It is now evident that many diagnostic artifacts were completed at quarry/workshops such as the Strathcona Site. Evidently this site was an important lithic source throughout the Middle to Late Prehistoric Periods and was frequented by the Northern Plano, Tunaxa, Napikwan and later proto-historic traditions (Pollock 1978). Recovery of Pelican Lake and Avonlea projectile points during the 1980 excavations now completes the Tunaxa Tradition which was previously only represented by McKean-Duncan-Hanna points. A recovered straight base biface may be related to the Pelican Lake Complex (Reeves 1970:143). Additionally, recovered pottery and small end scrapers may very well be associated with the more plains-oriented Avonlea Complex (Reeves 1970:140).

LITHIC DESCRIPTION AND QUANTIFICATION

The 1980 lithic sample was mainly comprised of various types of lithic debitage and very few artifacts or tools. Such a pattern is expected from a quarry/workshop where few other activities except raw material procurement and reduction took place. Prominent artifacts include various types of bifacially and unifacially flaked tools. Quartzite comprised the major raw material at the site. Petrified wood was also important probably because it contained amber-like concretions that were excellent for tool making. Perhaps the most unique and important artifact was an exhausted petrified wood rectangular-shaped blade core that showed evidence that blades were pushed or punched off.

REDUCTION METHODS AND TECHNIQUES

Major emphasis was placed on attempting to more explicitly describe and define quartzite cobble reduction techniques from lithic debitage. All too often definition and descriptions of reduction techniques by others are too vague or are based on little or no data. The Strathcona Site is an excellent site for such investigations, since the entire lithic reduction sequence should be present in the lithic assemblage. The first major study objective was to strongly refute the supposition that quartzite core tools were manufactured at such sites, as some researchers seem to suggest. Reduction of a complete cobble to a thin blank or biface is almost physically impossible, even by the best craftsmen. This method is a waste of raw materials and is probably the least efficient of all quartzite cobble reduction techniques. Furthermore, a cursory examination of the Saskatchewan Sands And Gravels indicates that there are few cobbles which even closely resemble ideal cobbles that would be required if a core tool reduction technique were being used (ie. very large, flat cobbles).

The second major study objective, which is also often misunderstood, involves the manufacture of usable blades which were either produced from blade cores or from bipolar cores. The bipolar reduction method produces usable flakes or spalls that are removed from large cores, and removes blades or usable flakes from small pebbles. Exhausted bipolar cores are the by-product from these activities and were not reduced to be used as blanks in the production of other artifacts.

The lithic debitage analysis indicates that all reduction methods were used at the Strathcona Site during various reduction stages. Also, the analysis revealed that a variety of reduction techniques were used, ranging from a hand held percussion cobble splitting technique to the removal of spalls from prepared multiplatform cores. A series of diagnostic flake types were produced from the initial removal and subsequent reduction of spall or flakes. To some extent each technique is dependent on physical properties of cobbles. Also, identification of all reduction phases indicates that quarry/workshops did not solely function to simply produce blanks that were later finished at other habitation sites. Finally, the lithic assemblage was examined to determine where one

particular reduction method was prominent at the site. The results were negative and suggest that an array of lithic reduction methods was used. Presently a lack of data on various lithic debitage proportions that occur from each technique has hampered these investigations.

INTRA-SITE AND INTER-SITE COMPARISONS

TEMPORAL TRENDS

Presently, a lack of sound stratigraphic artifact control has caused problems in defining temporal lithic technological change. A general temporal analysis was carried out using artifact, debitage and raw material attributes that would reflect changes in reduction techniques and stages. The results indicate that the present lithic assemblage is temporally homogeneous. Little significant variation in reduction techniques or raw material use was noted in the sample. Such a trend is presently somewhat contradictory since obvious prehistoric culture change occurred in the region. Certainly many of the attributes that were chosen to test prehistoric techno-economic change are sensitive measures of this change since they are directly affected by the degree of lithic variability in reduction techniques.

However, an inability to measure prehistoric culture change from lithic assemblages seems to also indicate that there exist some very constant variables in lithic reduction techniques that do not change significantly temporally, even when completed cultural assemblages show considerable temporal variation. This variability cannot be identified by present research techniques, which is both frustrating and at the same time enlightening. If there is little variability in the initial lithic reduction stages (which may have been caused by raw material physical restraints) then researchers must begin to look for other, more sensitive measures of change in the lithic assemblage. It seems that the greatest variation in technological lithic attributes occurs in the final reduction stages. Presently very few of these attributes have been identified or quantified by researchers. Such shortcomings indicate that more replicative experiments must be conducted on the final lithic reduction stages in order that a list of diagnostic attributes can be compiled. Of course such attributes are only useful if the final

lithic reduction stages occurred at the site. However, presently there is some indication that such a pattern did occur.

ON-SITE VERSUS OFF-SITE ACTIVITIES

The preliminary results from comparison of the upper and lower terrace lithic samples suggest that primary quartzite reduction stages took place at the site as well as nearer to lithic sources while more vitreous raw materials were completely reduced at the site. The presence of relatively higher quartzite decortication flakes and core frequencies on lower terraces indicates that instead of carrying large, complete cobbles back to camp, some spalls and flakes were removed near raw material sources. The fact that the initial quartzite reduction stage was also conducted on the upper terrace, may have been influenced by quartzite heat-treatment. The almost total lack of vitreous lithic material in lower terrace samples may be due to differences in recovery methods that were used in the survey. Alternatively, very little primary reduction of this small raw material may have been carried out on lower terraces since it could be easily be transported back to the site or to other sites in the area. To conclude, the preceding preliminary analysis strongly suggests the importance of an area-oriented research scheme. Before more concrete conclusions can be made, a more rigorous sampling design and larger sample is required from lower river terraces. Such research will eventually lead to a better understanding of on-site versus off-site reduction activities in the Strathcona area.

REGIONAL SITE COMPARISONS

Comparison of the Strathcona Site lithic assemblage to the Prosser and Stony Plain assemblages was intended to better define quarry/workshops by their lithic assemblages and the degree that these samples vary from other regionally related sites. The analysis was hampered by an inconsistency in lithic classificatory methods. The preliminary results were somewhat surprising since the Strathcona lithic assemblage and Prosser Site assemblage were only slightly different but both samples differed considerably from the Stony Plain lithic assemblage. However, some significant differences in flake types and core frequencies also occurred between the Prosser and Strathcona Sites.

The above results are not entirely convincing and require future

re-evaluation. The major differences between the Strathcona Site and Stony Plain assemblages may be primarily due to classificatory or analytical inconsistencies rather than in site function or activities. For example, major differences between the two assemblages occur in the 'artifact frequency' category which is extremely high at the Stony Plain Site. Most of these artifacts are edge modified flakes which may have seriously biased such comparisons. Also, the relatively low 'decortication flake' frequencies at the Stony Plain Quarry may due to classification and descriptive inconsistencies since such flakes should occur in much higher frequencies at quarry/workshops. However, their low frequencies could also be explained by greater off-site initial reduction activities.

Future site lithic assemblage comparisons must first solve those classificatory problems that were encountered in this analysis, before any conclusive inferences regarding regional site lithic assemblage variation are reached. However, it is felt that the attributes used to compare these sites are essential and should be incorporated in future inter-site comparisons. Secondly, a larger regional site sample is necessary before more valid site comparisons are forthcoming. This will also enable researchers to use multivariate statistics, such as a Principle Component analysis, which will more objectively define the degree of similarity, or difference, between site lithic assemblages. Moreover, this method will reveal which variables are more responsible for assemblage differences. Such data collecting should be an essential part of any future site research design and eventual regional synthesis.

LITHIC CLASSIFICATION

Many opinions have been expressed regarding lithic classification schemes, their construction, and their potential in resolving prehistoric analytical problems (Clarke 1968; Sabloff and Smith 1969; Rouse 1970; Dunnell 1971; Whallon 1971; and Hill and Evans 1972). Clarke (1968) and Hill and Evans (1972) have convincingly argued that archaeoogical data can be classified in many different ways and no particular method is necessarily the best. Thus, it is argued that there exists no universal classification system, only many that each attempt to solve

specific research problems.

This argument also applys to parkland prehistoric lithic assemblages. That is, there exists no 'ideal' lithic classification system, nor can all lithic attributes ever be recorded to entirely satisfy all researchers. This problem already becomes quite evident when attempting to use lithic samples from other sites for comparative purposes. Classification schemes can only be constructed to resolve specific research problems and must be relatively flexible to account for a great deal of variation that occurs in lithic assemblages. Such a scheme is more satisfactory than a more traditional, normative approach (Rouse 1970) which is often too inflexible to be of any analytical use.

A more detailed synthesis of spatial and temporal comparisons was made possible only when a thorough identification and description of lithic reduction techniques and choice of diagnostic attributes was completed. This objective was accomplished by emphasizing the need for a lithic debitage analysis. A series of flake types were described that effectively document stages in lithic reduction, but also allow some insight on particular lithic reduction techniques. These flake types therefore are the basis for defining prehistoric technological techniques. Future analysis and more replicative experiments will undoubtedly refine and add to this flake classification scheme especially in other raw materials which were not thoroughly investigated. Also, little is known about distinctive flake type relative frequencies and importance, that result from the final stages of tool shaping and thinning. Therefore, every effort must be made in the future to define these variables more explicitly since they may be key attributes when attempting to document technological change by using lithic debitage.

The study also attempted to isolate additional variables that would help identify different reduction methods and techniques. To this end, a list of attributes was proposed that would distinguish bipolar from other percussion reduction methods. A total of four core types were defined that describe particular reduction techniques.

Investigations of subsequent temporal comparisons, intra-site activities and inter-site comparisons all used debitage types which were initially described and defined in the lithic analysis. Additional

variables such as raw material frequencies and types were important in attempting to establish whether any temporal technological changes occurred. Similar lithic categories were also used to compare lower and upper terrace lithic assemblages. Therefore, there exists a need to normalize various site lithic assemblage typologies in which some of the above variables should be considered.

To conclude, the preceding study has not attempted to investigate the many other problems that data from this quarry/workshop could resolve. Many of these problems have already been thoroughly discussed by Ives (1980) and must await future analysis. It should be emphasized that these problems will require additions, deletions and perhaps alterations to the lithic classification scheme that was used in this study. However, this scheme is essential to understanding lithic technological methods and physical constraints that may have affected them. Such inferences form the basis for any future, more elaborate research designs and regional syntheses. Only when intra-site technological variability is understood, can inter-site regional techno-economic patterns be either spatially or temporally clearly defined.

RECOMMENDATIONS

The following recommendations for future research are based on conclusions reached in this study and from suggestions that were previously proposed by Ives (1980).

FIELDWORK

A.

Continuation of thorough artifact recovery techniques is recommended for future excavations to ensure that lithic quantitative consistency continues. Therefore, either a five percent or ten percent bulk sample from each unit should be fine-sorted and all remaining unit matrix should be screened through a 0.5 cm mesh. Small artifact recovery will enable researchers to more effectively describe the later lithic reduction stages where many very small pressure flakes are often produced. The 1980 bulk sample results indicate that few diagnostic flakes are less than 0.5 cm in size. However, such results are apt to change in other areas of the site, especially where greater activities in final reduction may have occurred. Furthermore, it is suggested that recovery of micro-debitage remains is necessary since such remains may also be a good indicator of lithic reduction intensity (Fladmark n.d.).

B.

It is recommended that no further magnetometer surveys be conducted at the site until operators have carried out sufficient experimental work to ensure that greater control exists of the many variables that can cause high magnetic anomalies. Furthermore, if, and when additional magnetometer surveys are required a 'greater' effort should be made by operators to clear the anomaly area of surface metal objects. This can be accomplished by using high quality metal detectors and also by thoroughly, visually examining and raking the entire area.

Also, it is suggested that one anomaly area be chosen and completely excavated. These investigations will resolve the problem of whether hearths were absent because only a small area was excavated. Also, data can be gathered on what the spatial relationship between hearths and

anomalies are. These excavations can be co-ordinated with public display units.

C.

It is suggested that because there is presently a failure to demonstrate that there exists any cultural stratigraphy at the Strathcona Site, future excavation and recovery methods should be changed accordingly. However, this does not imply that all stratigraphic research totally be abandoned.

Effective vertical artifact control can be maintained by excavating one meter units in either five centimeter or 10 cm levels. It has already been established that frost-heaving has caused some vertical artifact displacement. Thus, these arbitrary intervals should sufficiently maintain vertical artifact control. A change to two-dimensional mapping will also help speed up operations which may be necessary if the site is to be adequately sampled within the presently alotted time period.

In addition to these changes in recovery methods, research should also be continued to investigate artifact stratigraphy at the site. Such investigations should start near Units 12, 16 and Unit 17 which seem to be potentially productive areas for such investigations. Furthermore, it is recommended that these areas be excavated in such a manner as to minimize any topographical variation so that recorded artifact depths are not affected by this variable. One way of accomplishing this involves excavating very narrow, long sections and then mapping all exposed artifacts three-dimensionally. These sections should be less than 10 cm wide and can be removed from the sides of larger, finished excavation units.

Finally, greater attention should be paid to B-horizon depths. The possibility exists that this horizon can be used as an arbitrary starting point for measuring artifact depths. In other words, the profile is turned upside down and will eliminate the variability in depths that occur from surface disturbance. Thus, artifacts from individual unit levels can be easily compared. Of course such a method assumes that the B-horizon is a more consistent natural level from which to take vertical measurements.

D.

With regards to the above problem, more thorough paleoenvironmental data, especially a paleopedological analysis of the site, is required to examine temporal soildepositional rates which are presently considered to have been constant throughout the Middle to Late Prehistoric Periods. Such data may already be available from other area studies. Nevertheless, such an analysis should either be undertaken at the site, or the necessary available data should be collected.

E.

Lower terrace survey test excavations have exposed faunal concentrations in an area that is located south of the site near Pine Creek. More extensive excavations are required to determine the significance of these remains.

F.

It is essential that an intensive sampling design be immediately operationalized in order that a relatively representative sample can be collected. However, it must be emphasized that any future sample may already be substantially biased since a good part of the site has already been destroyed by recent landfill activities. Thus, the target population and parameters must be restricted to that portion of the site that is remaining and must assume area homogeneity. In other words that portion of the site still left undisturbed is assumed to represent what once was the entire site.

The first step is to stratify the Strathcona Site area. This will increase sampling precision by decreasing area variability. The upper and lower terraces should be separately sampled. Lower terraces can be sub-divided to conform to the arbitrary artifact ratios presented in this study, or they can be divided into north and south sections.

Presently, it is more difficult to incorporate a viable sampling design for the upper terrace. A lack of natural stratigraphic control and the fact that the lithic analysis suggests that temporal lithic homogeneity exists, helps in choosing a sampling design. Nevertheless, the large area that must be sampled still make this a very imposing project. It is suggested that a stratified, systematic, unaligned random sample

be used. This sampling design ensures that units are more evenly spaced over the entire area.

One meter units should be randomly chosen from each arbitrary 20 meter grid quadrat. Small excavation units should result in minimal error since the sampling fraction is relatively high. The number of excavated units in each 20 meter quadrat can be derived by numerous methods. If a 10% sample from each quadrat is desired then 40 units should be randomly chosen. Presently there are roughly 25, 20 meter quadrats on the upper terrace. Therefore it would require 1000 one meter units to recover a 10% sample. A five percent sample would require 500 excavated units but accuracy decreases with a smaller sample. If the site is excavated for five additional years then either 100 to 200 one meter units would have to be excavated on the terrace during every field season.

Alternatively, a multi-stage sampling design could be used. Here each 20 meter quadrat is divided into four equal portions, one 10 meter squareis randomly chosen in each quadrat, and 10 one meter units are selected from the 10 meter square. For this method a total of 250 one meter units must excavated. However, use of a multi-stage sampling design will also add another source of calculated error and is less precise than a single-stage design.

Choosing the number of one meter units that must excavated for each 20 meter quadrat can also be done by using a discovery model which ensures that each artifact class in the total artifact population will be represented. Therefore, the number of one meter units to be sampled is directly related to the number of test units it takes to find all the artifact classes, or:

$E(N) = XN/k + 1$, where:

$E(N)$ = Estimated number of units that must be excavated in each quadrat.

N = Total number of excavation units in each quadrat (400).

X = Number of units required to find all item classes (1).

k = Number of artifact classes in the entire artifact population (15).

$E(N) = 1 \times 400/15 + 1 = 25$ one meter units.

Presently the 1980 unit artifact samples indicate that at most one or two one meter units are adequate to recover all artifact classes. Therefore, between 25 to 50 units per 20 meter quadrat must be excavated. This number can be reduced by using the above multi-stage sampling design.

One final word of caution, regarding the incorporation of a sampling design at the Strathcona Site must be mentioned. The type of sampling design is dependent on what future research objectives are chosen by others in the future. If some problems on artifact clusters, or other spatial analyses have been chosen, then a cluster sample will be necessary so that relatively large areas can be totally excavated. But before such a sampling design can be used, some idea of relative activity area sizes must first be estimated. Problems with this research might occur since no stratigraphic control is present at the site. Thus, it will be almost impossible to determine which artifacts are temporally related and what clusters are significant.

ANALYTICAL METHODS

A.

A more thorough replicative quartzite cobble reduction analysis is required in order to establish what debitage attributes might best describe various lithic reduction techniques. Currently little is known about what the percentage of various flakes types are for different reduction techniques. Once these expected relative and absolute frequencies are established, then they can be compared to recovered debitage samples. Such data will allow more objective inferences on reduction techniques to be made.

B.

Based partly upon the above experiments, the present lithic classification system can be greatly refined and will be able to more explicitly identify reduction phases and distinguish between reduction methods.

C.

Once a representative lithic sample is collected, then multivariate statistics should be carried out using a much larger regional site

sample than was used in this report.

PUBLIC CONSIDERATIONS

A.

The site should be opened for the public much earlier in order that school tours can take place. The potential of this site for educational purposes is great and has not yet been fully tapped.

B.

Demonstrations in lithic reduction techniques should be part of the archaeological exhibit, especially on those days when public turnout is high.

C.

One large area should be excavated for public viewing near the boardwalk. Such a large excavation will be both interesting and may expose hearths or other features.

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APPENDIX I

UNIT TWO-DIMENSIONAL DIAGONAL ARTIFACT PLOTS

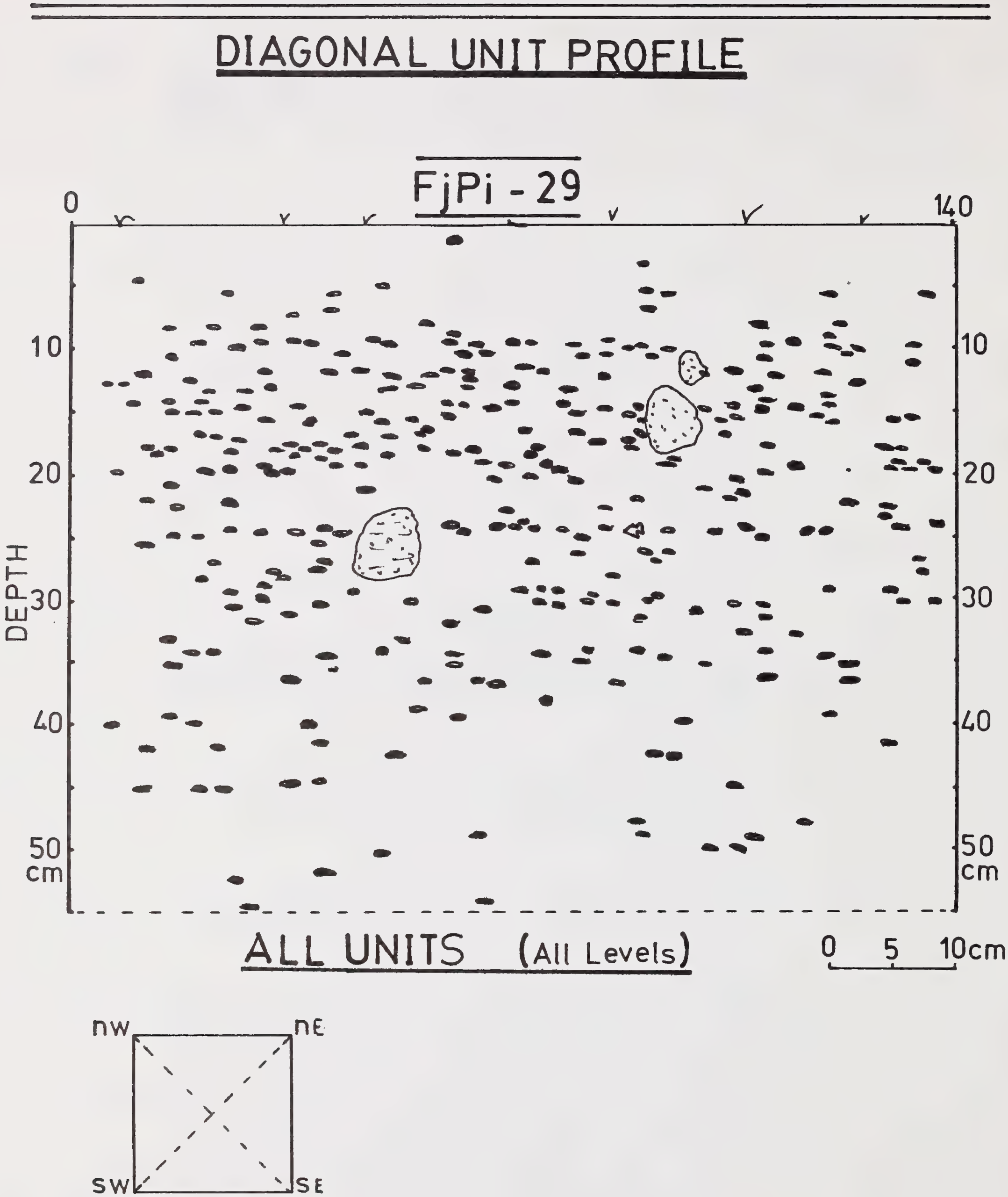

Figure 40. Two-dimensional artifact plots.

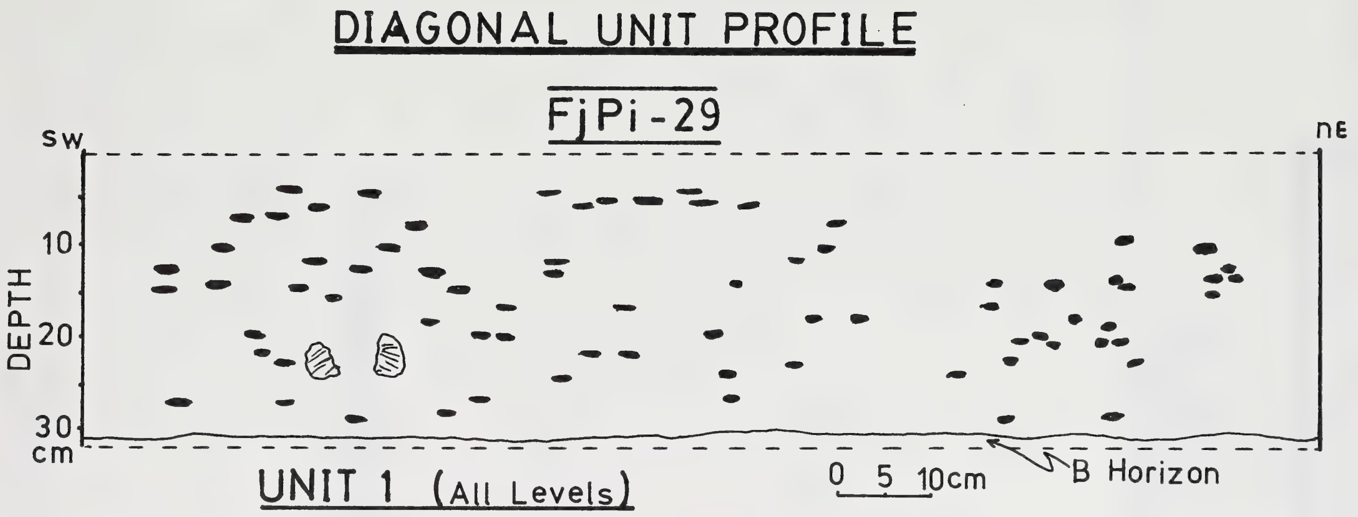

Figure 41. Two-dimensional artifact plots.

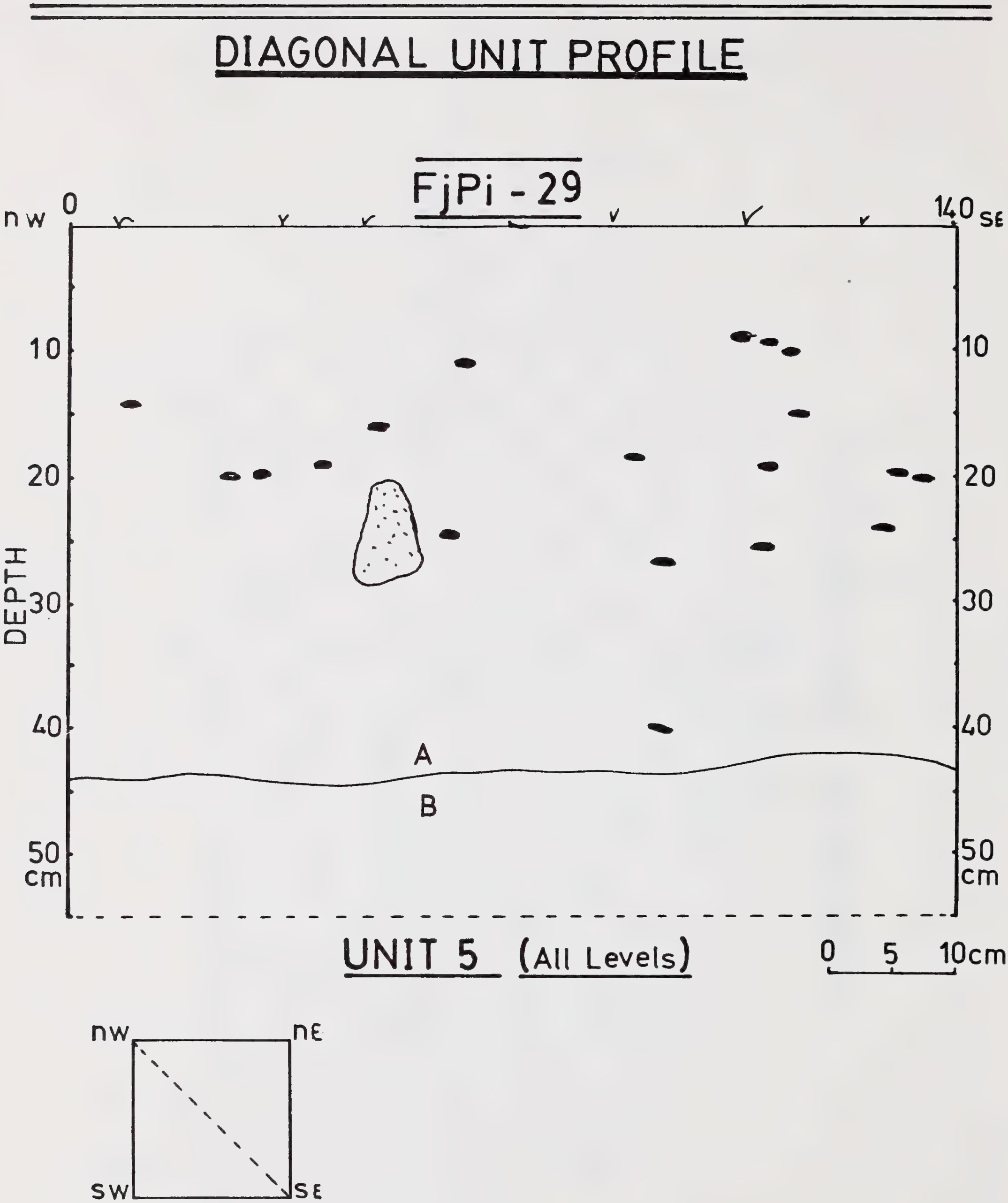

Figure 42. Two-dimensional artifact plots.

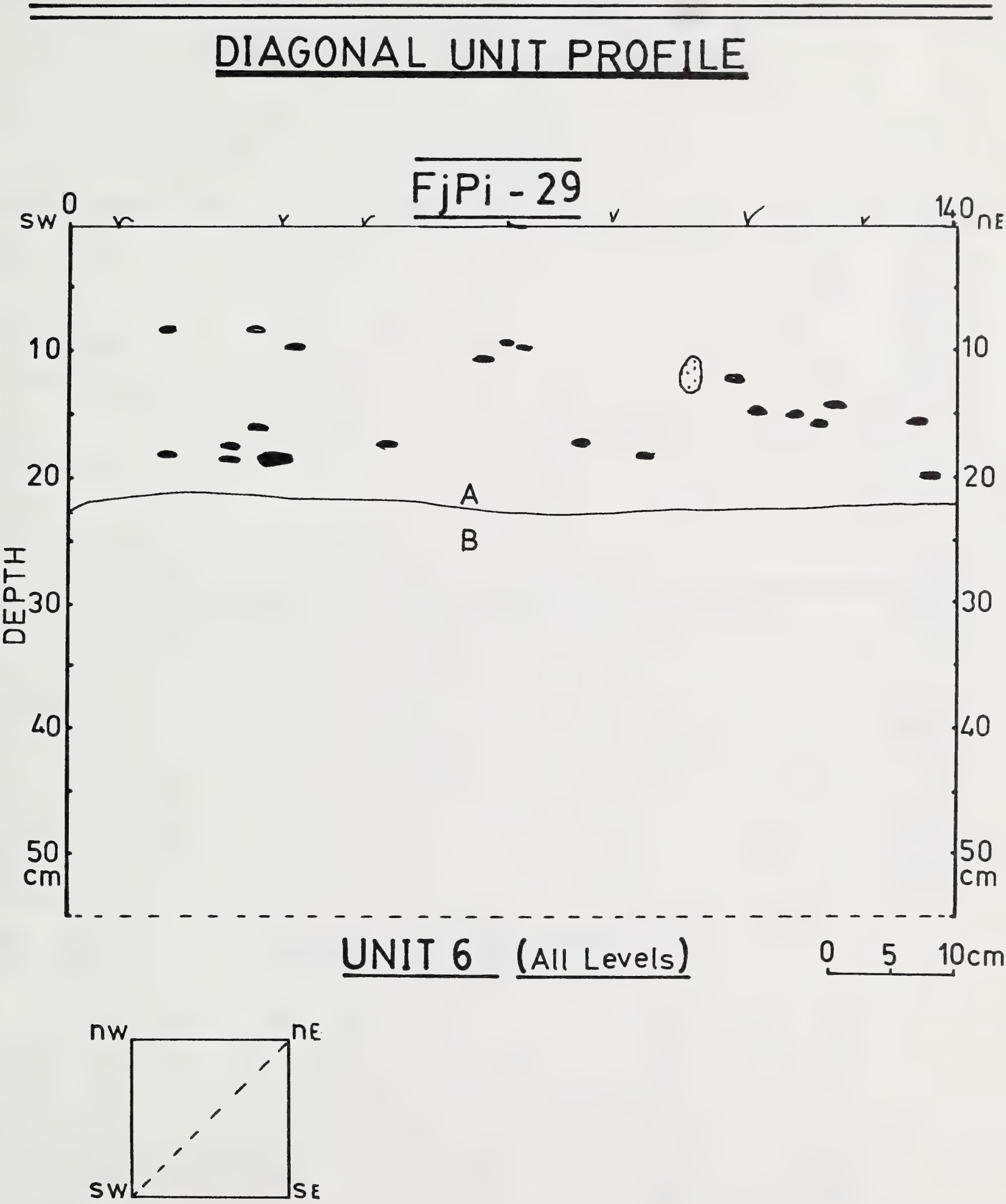

Figure 43. Two-dimensional artifact plots.

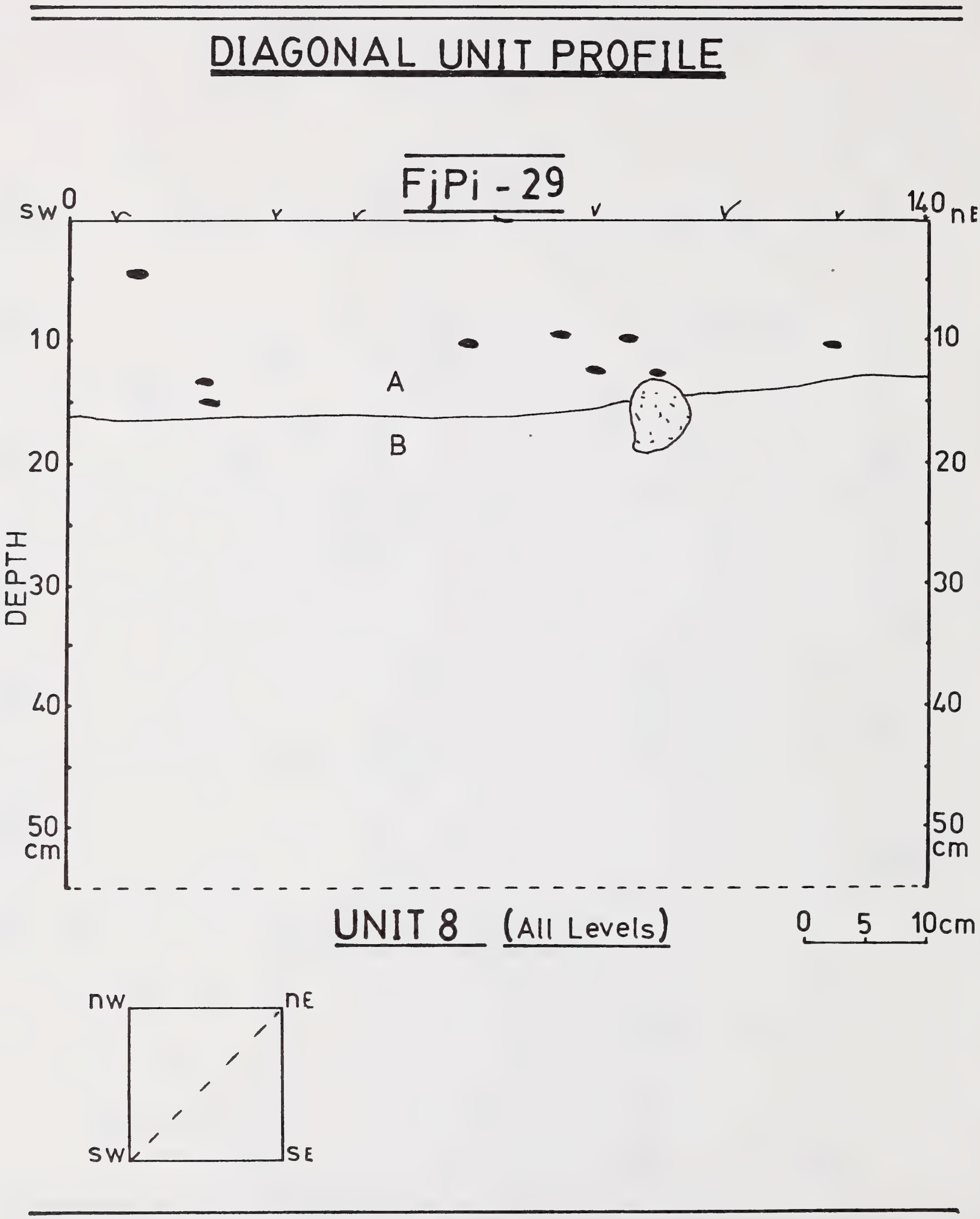

Figure 44. Two-dimensional artifact plots.

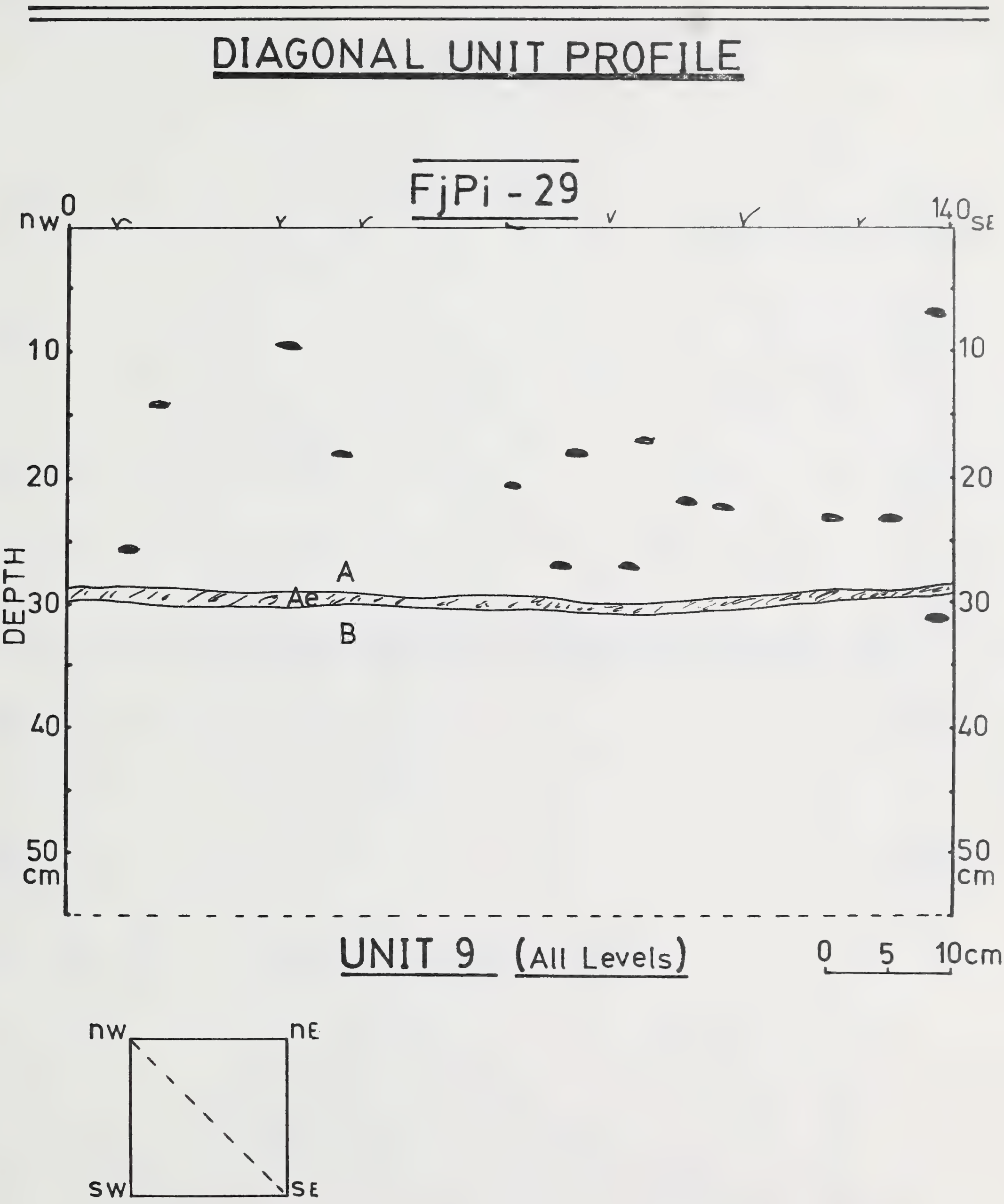

Figure 45. Two-dimensional artifact plots.

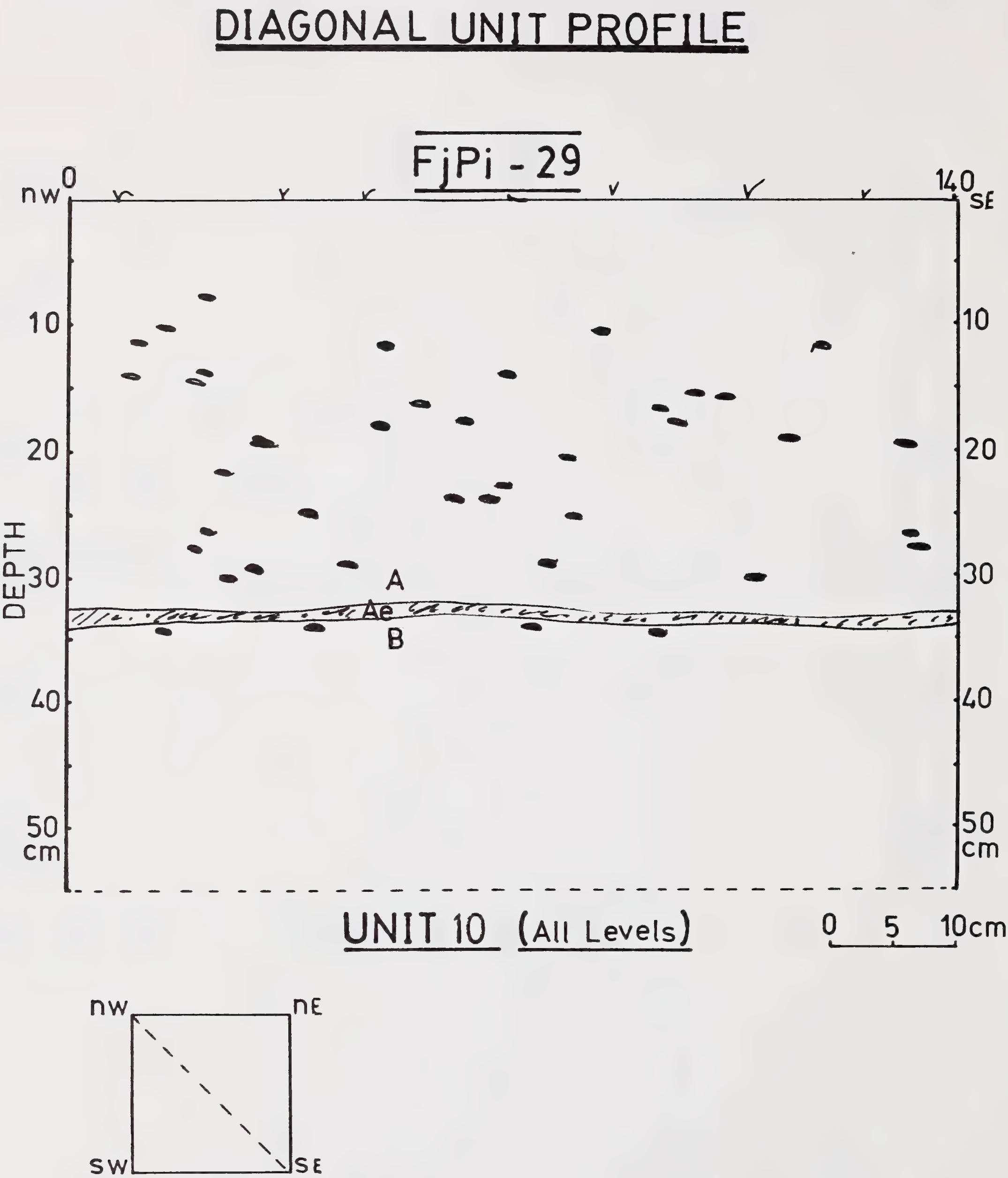

Figure 46. Two-dimensional artifact plots.

DIAGONAL UNIT PROFILE

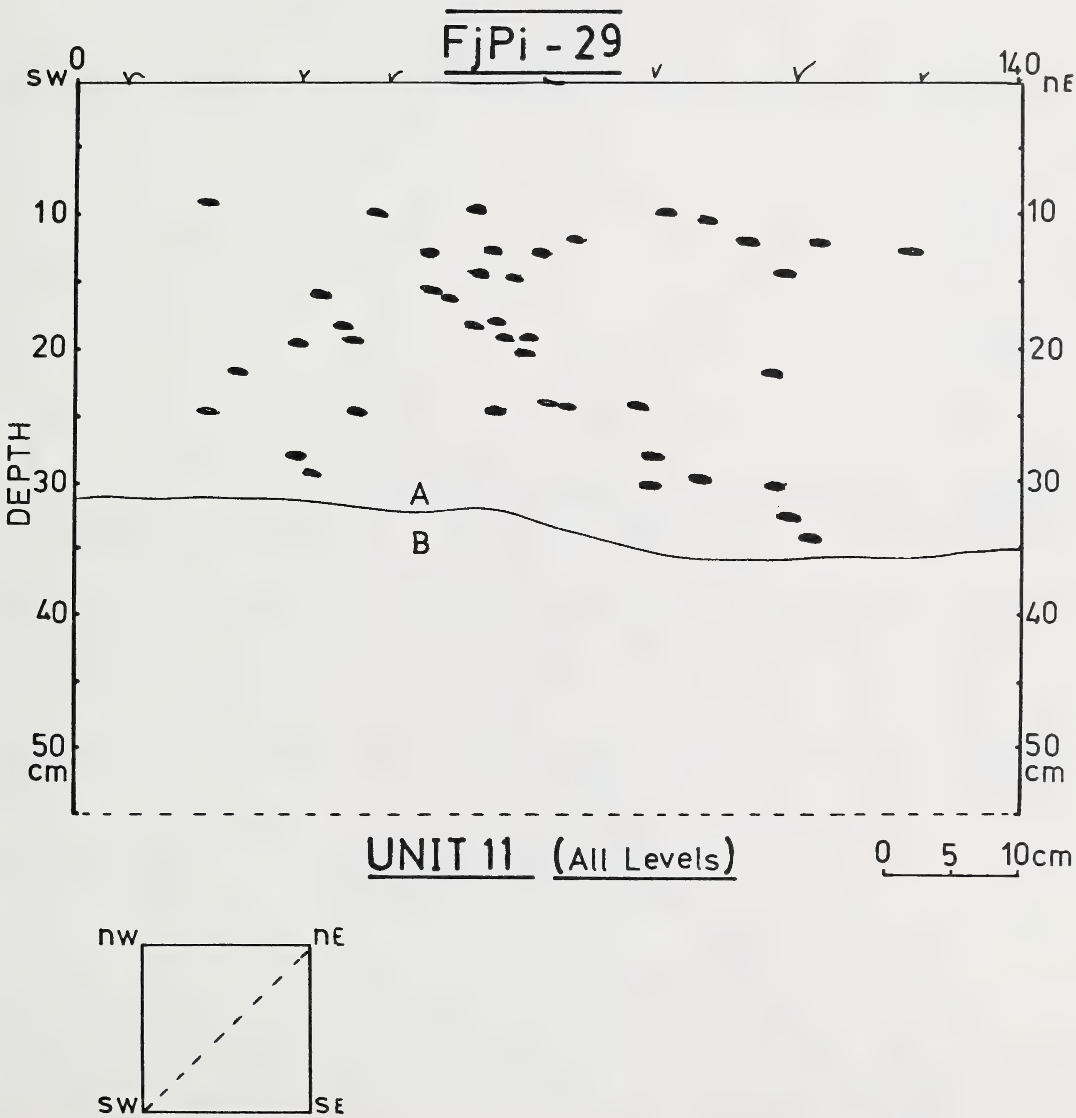

Figure 47. Two-dimensional artifact plots.

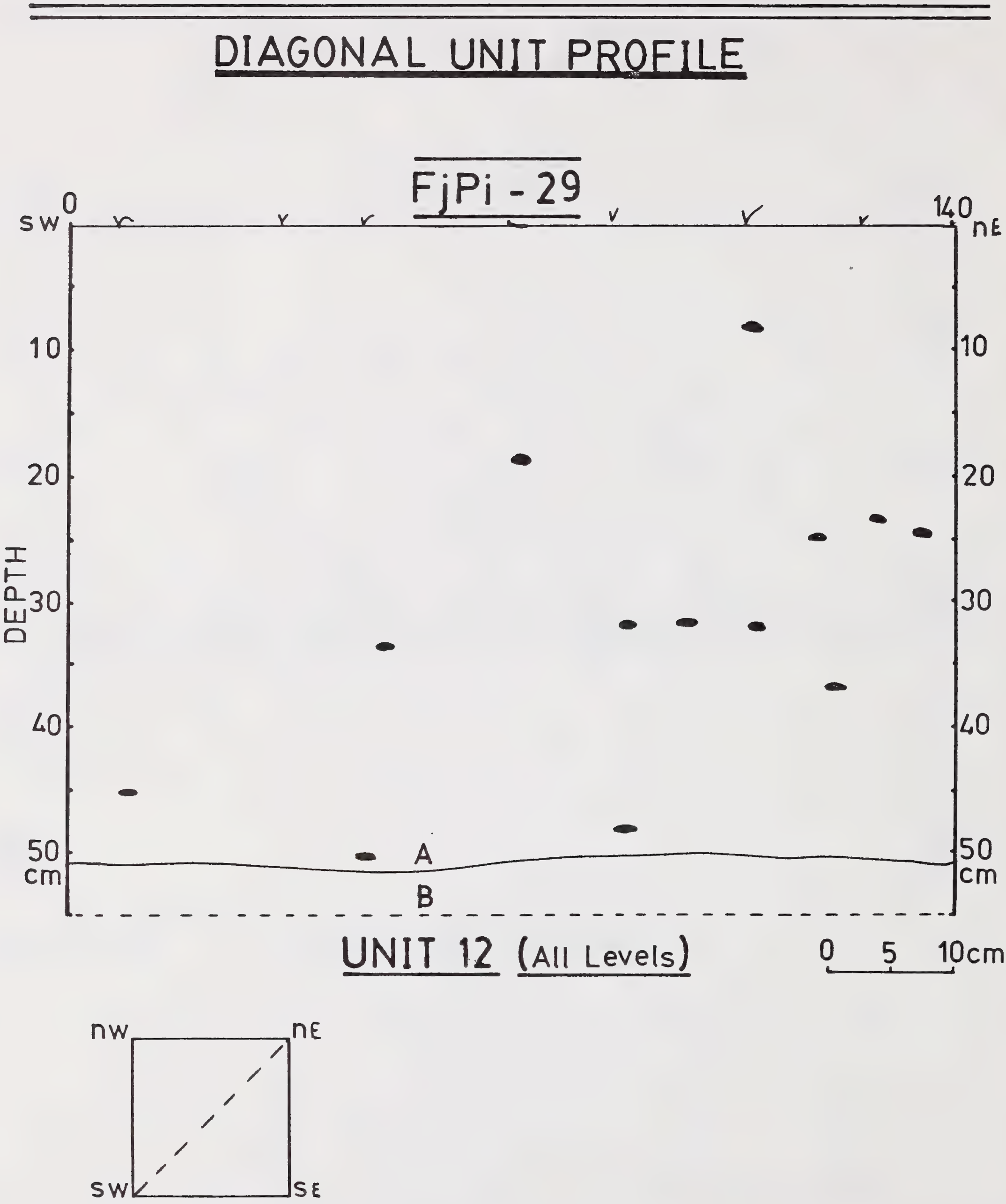

Figure 48. Two-dimensional artifact plots.

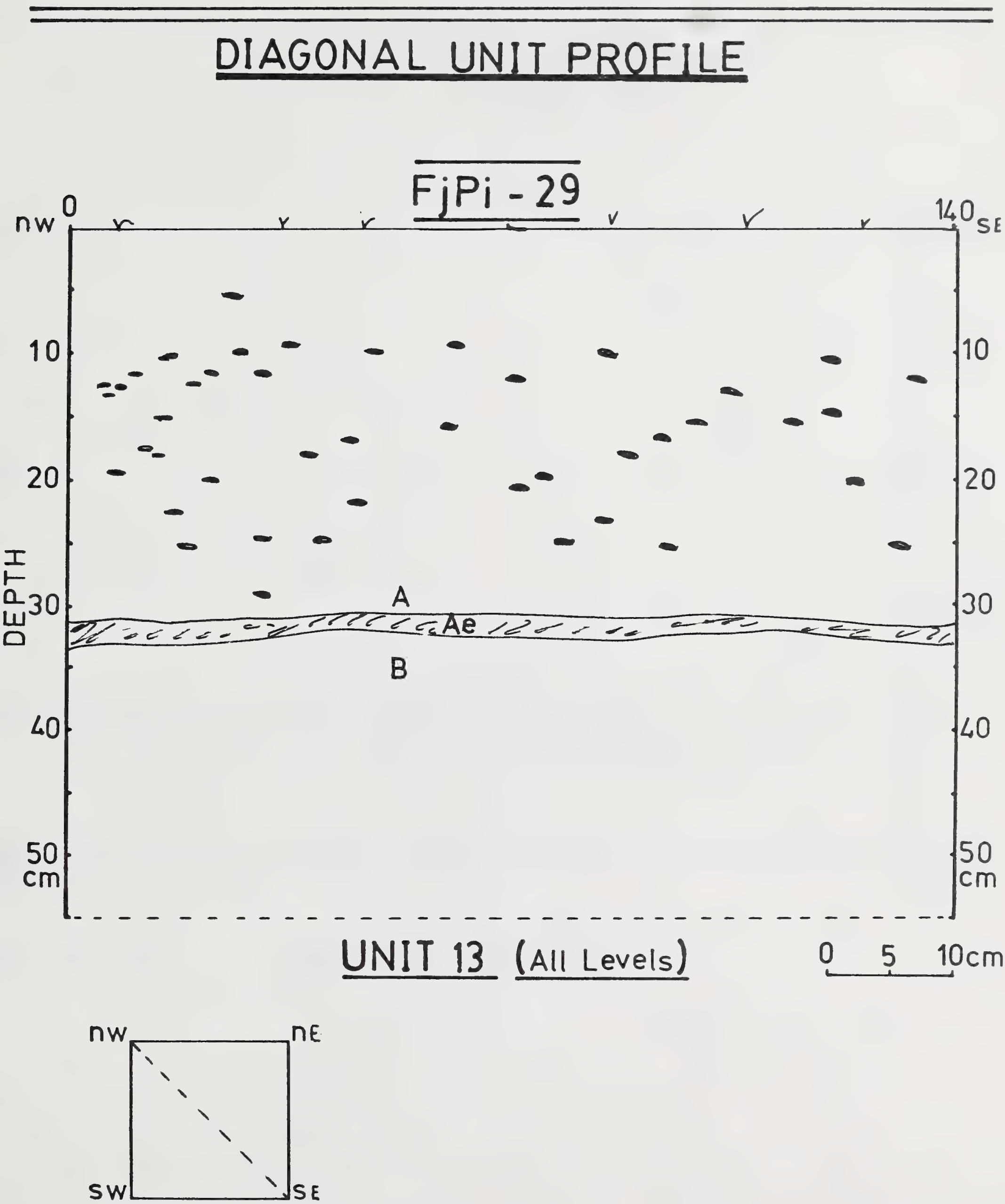

Figure 49. Two-dimensional artifact plots.

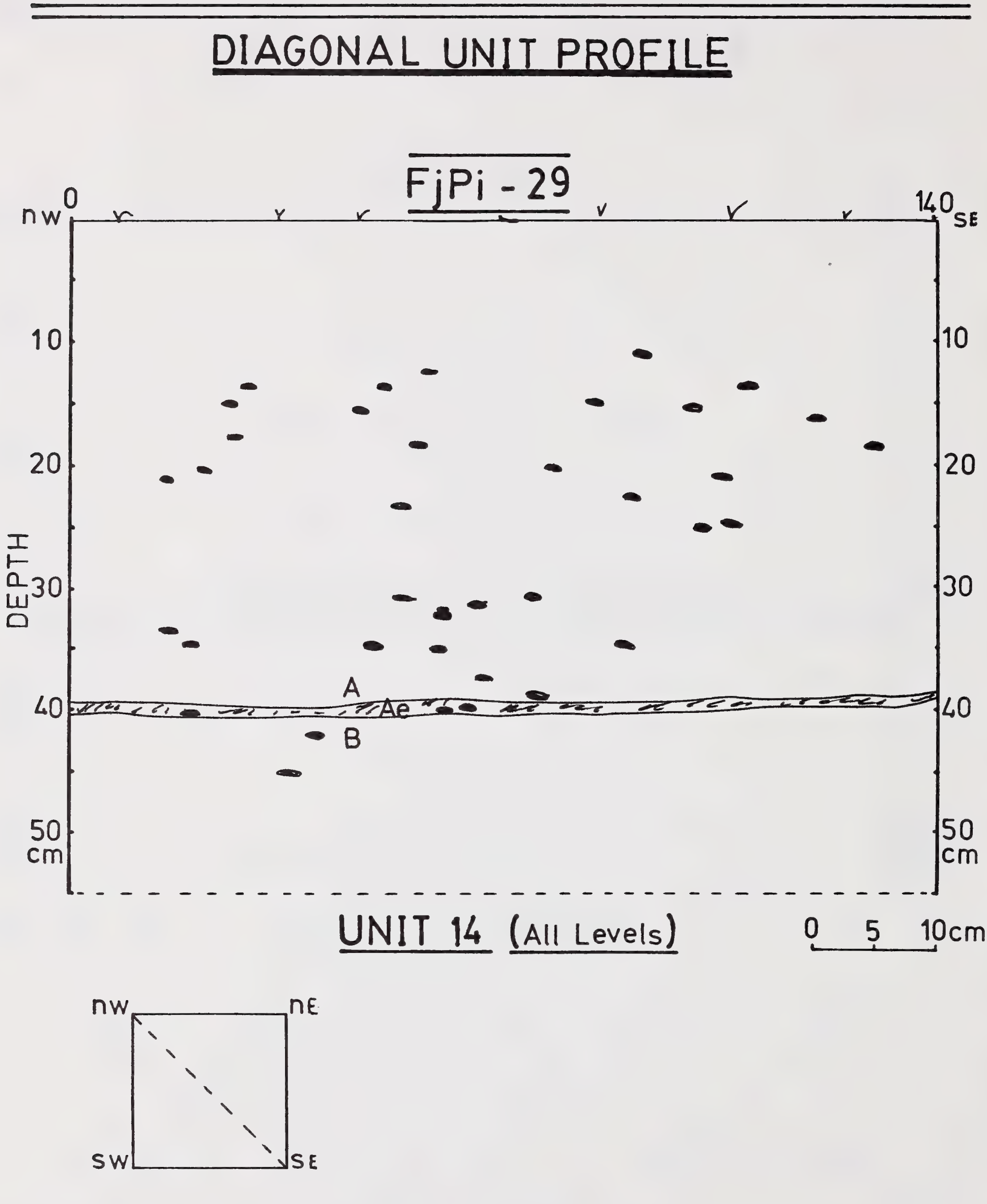

Figure 50. Two-dimensional artifact plots.

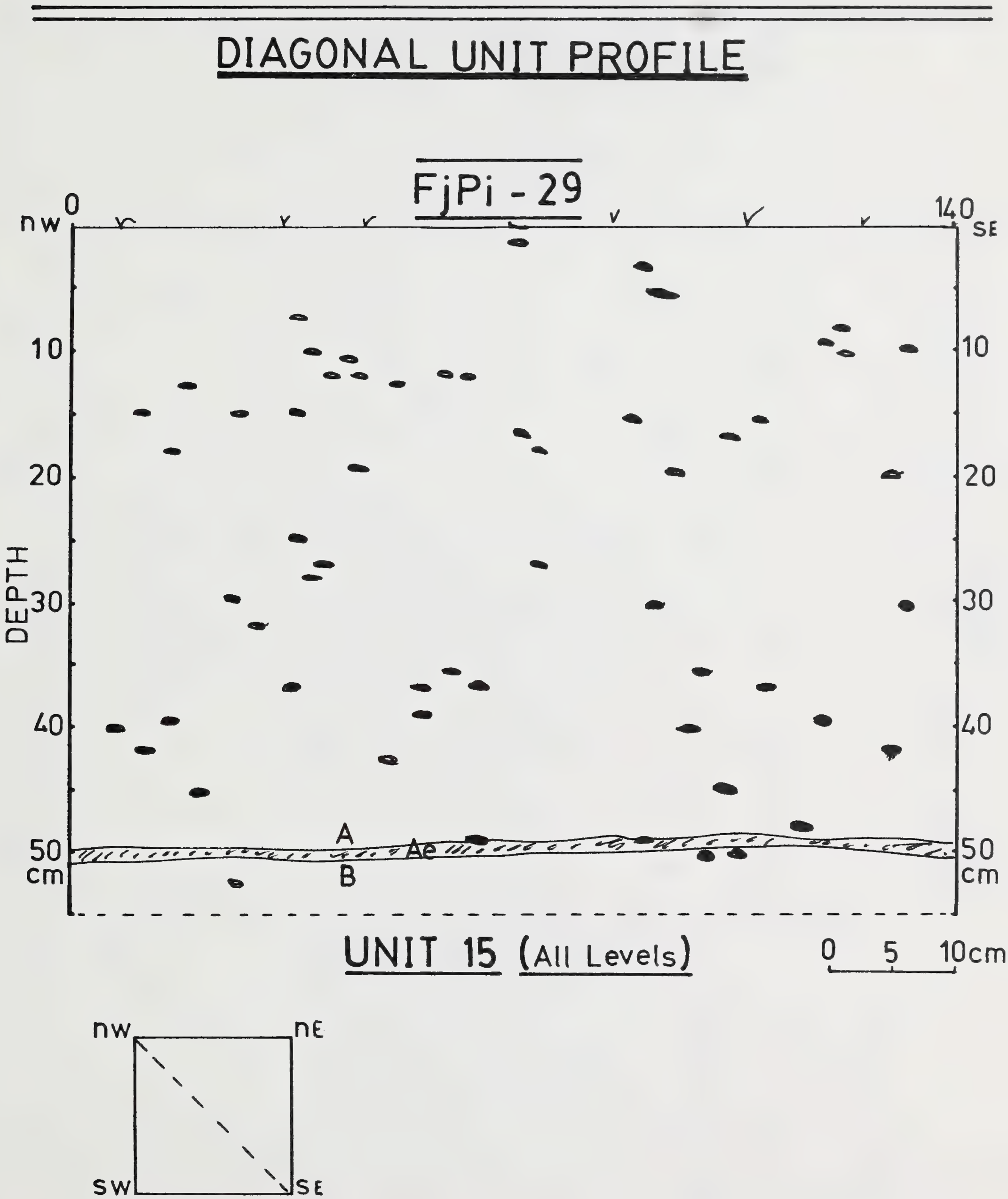

Figure 51. Two-dimensional artifact plots.

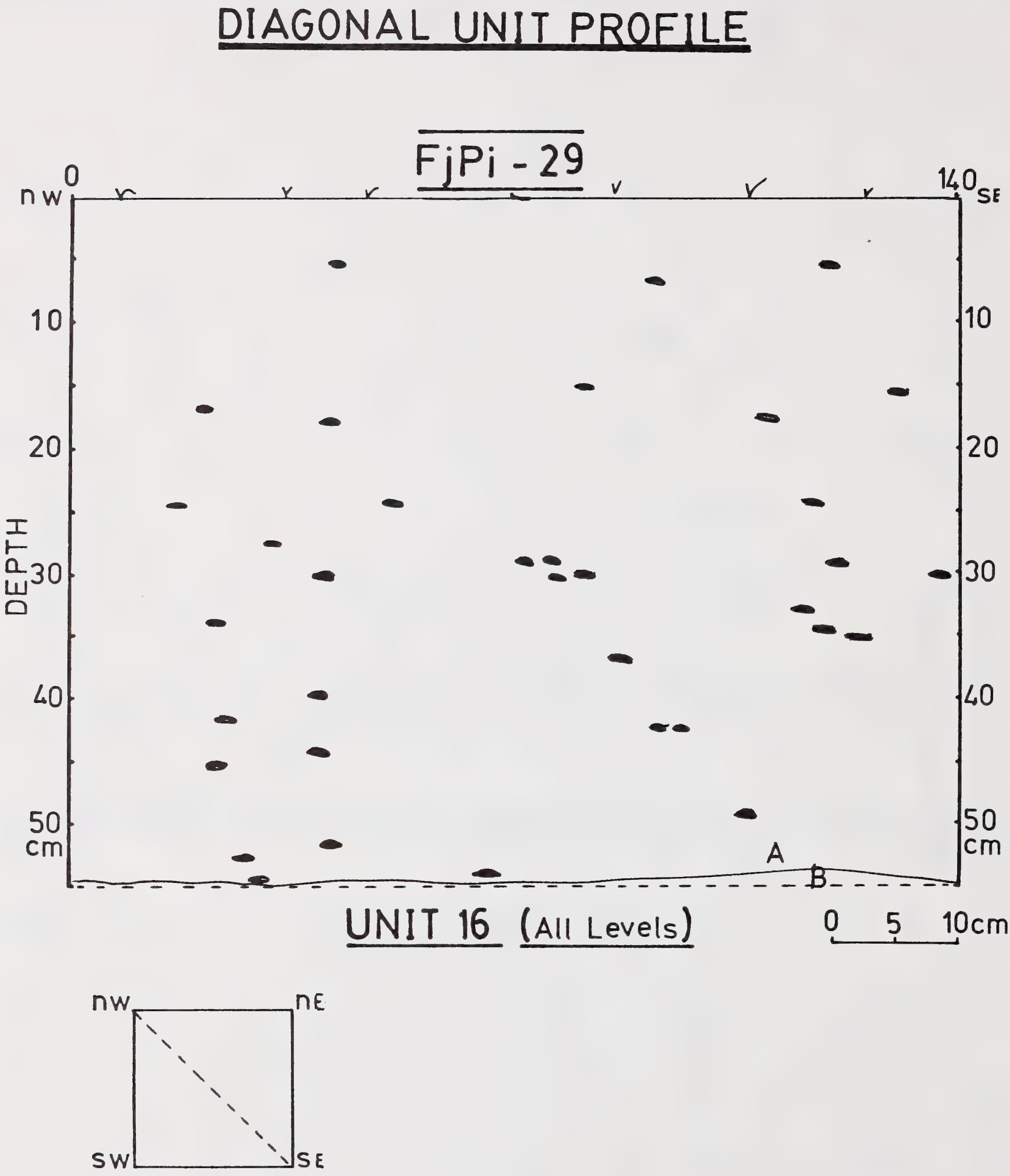

Figure 52. Two-dimensional artifact plots.

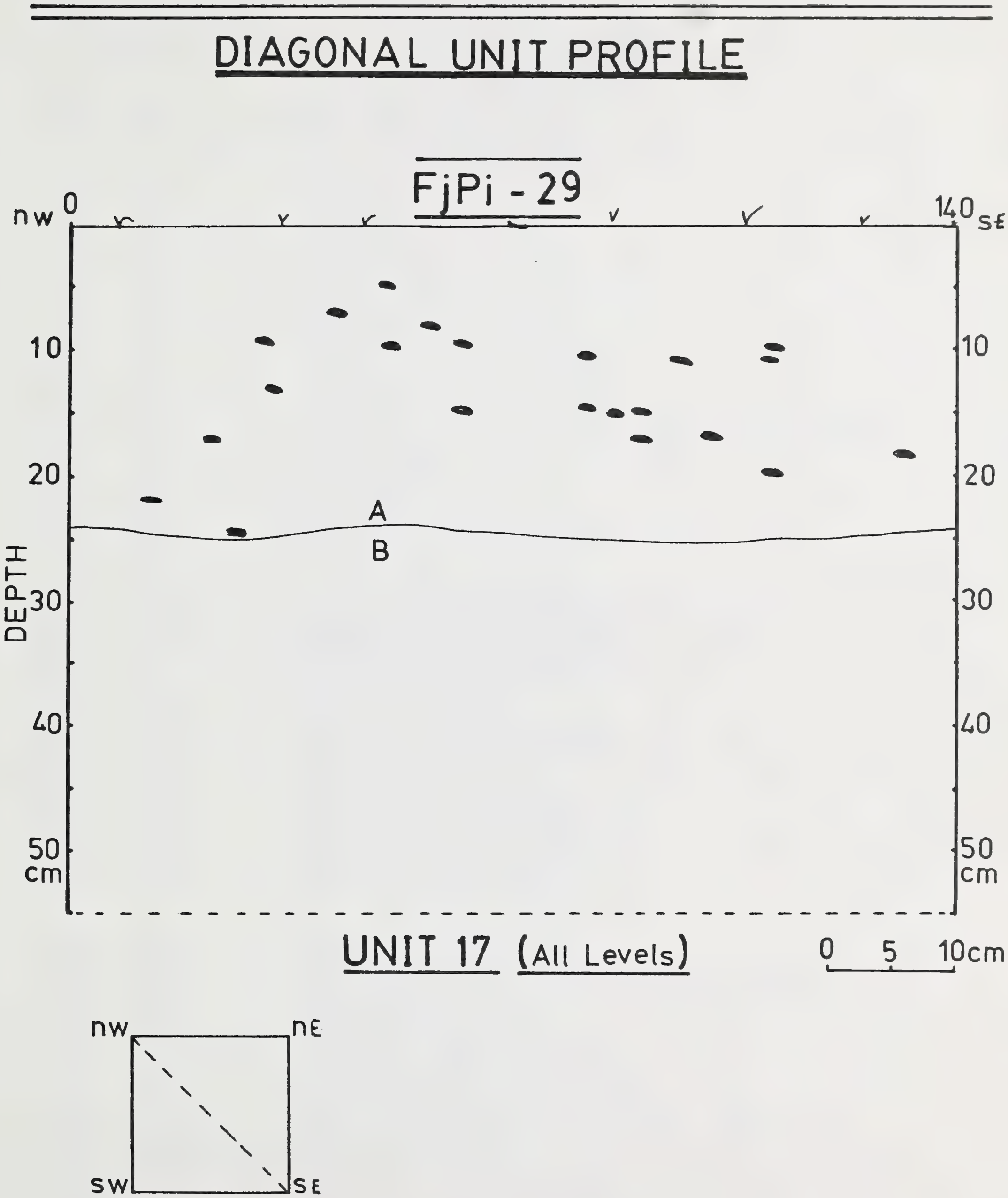

Figure 53. Two-dimensional artifact plots.

APPENDIX II

ARTIFACT RECOVERY FROM SITE BOUNDARY TESTS.

TRANSECT CO-ORDINATES	ARTIFACT DESCRIPTIONS
240E - 335N	Primary decortication flake.
240E - 340N	Quartzite spall.
240E - 345N	Fire-cracked rock (quartzite).
220E - 290N	Charred bone fragments (8).
220E - 290N	Quartzite split pebble.
220E - 295N	Quartzite split pebble.
220E - 295N	Large mammal vertebral epiphysis.
220E - 305N	Quartzite reduction flake.
220E - 310N	Quartzite split pebble.
220E - 335N	Quartzite pebble fragment.
220E - 340N	Quartzite biface fragment.
220E - 340N	Quartzite reduction flake.
220E - 340N	Quartzite bipolar primary decortication flake.
220E - 485N	Large mammal tooth.
220E - 485N	Large mammal tooth enamel fragment.
220E -525N	Quartzite spall.
220E - 540N	Quartzite secondary decortication flake.
220E - 540N	Calcined bone fragment.
200N - 305N	Quartzite secondary decortication flake.
200N - 325N	Quartzite pebble fragment.
200N - 325N	Quartzite cobble fragment.
200N - 340N	Quartzite exhausted core.
200N - 355N	Quartzite shatter.
200N - 360N	Quartzite pebble fragment.
200N - 360N	Quartzite primary decortication flake.
200N - 485N	Chert? exhausted core.
200N - 495N	Quartzite fire-cracked rock.
200N - 495N	Quartzite fire-cracked rock.
200N - 495N	Sandstone hammer stone.
200N - 500N	Petrified wood shatter.
180N - 355N	Quartzite shatter.
180N - 365N	Quartzite bipolar core.
180N - 370N	Quartzite secondary decortication flake.
180N - 370N	Bone fragment.
180N - 375N	Quartzite reduction flake.
180N - 375N	Quartzite bipolar core.
180N - 470N	Quartzite fire-cracked rock.
180N - 471.5N	Quartzite primary decortication flake.
180N - 471.5N	Quartzite shatter.
180N - 471.5N	Quartzite bipolar primary decortication flake.
180N - 475N	Quartzite flake fragment.
180N - 500N	Quartzite fire-cracked rock.
180N - 505N	Quartzite shatter.
160N - 330N	Quartzite pebble fragment.
160N - 365N	Quartzitc pebble fragment.
160N - 395N	Quartzite fire-cracked rock.

TRANSECT CO-ORDINATES	ARTIFACT DESCRIPTIONS
160E - 465N	Chalcedony shatter.
160E - 470N	Quartzite cobble fragment.
160E - 480N	Chert? core.
160E - 480N	Quartzite primary decortication flake.
160E - 500N	Quartzite fire-cracked rock.
140E - 345N	Quartzite primary decortication flake.
140E - 380N	Quartzite primary decortication flake.
140E - 380N	Quartzite flake (edge modified).
140N - 385N	Quartzite secondary decortication flake.
140N - 395N	Quartzite primary decortication flake.
140N - 410N	Quartzite fire-cracked rock.
140N - 410N	Quartzite reduction flake.
140N - 410N	Quartzite split pebble.
140N - 410N	Quartzite shatter.
140N - 415N	Quartzite bipolar core?
140N - 415N	Petrified wood shatter.
140N - 460N	Quartzite bipolar flake.
30°W, 140E - 360N	Quartzite bipolar core.
30°W, 140E - 360N	Quartzite flake.
30°W, 140E - 365N	Quartzite pebble fragment.
30°W, 140E - 435N	Quartzite bipolar split cobble.
30°W, 140E - 435N	Petrified wood shatter.
60°W, 140E - 420N	Quartzite shatter.
60°W, 140E - 420N	Sandstone split pebble?
60°W, 140E - 435N	Petrified wood fragment.
60°W, 140E - 435N	Quartzite secondary decortication flake.
60°W, 140E - 435N	Petrified wood shatter
60°W, 140E - 435N	Quartzite split cobble (bipolar).
60°W, 140E - 435N	Quartzite secondary decortication flake.
440N - 70E	Bone fragment.
440N - 135E	Quartzite flake.
160N, 60°N - 460N	Quartzite reduction flake.
460N - 132E	Quartzite cobble core.

APPENDIX III

UNIT LITHIC SUMMARIES
(All Levels)

TABLE 13

LITHIC SUMMARY: FjPi-29

UNIT 1

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.	1							1
UNIFACES f.								-
EDGE MOD. FLAKES	6	3						9
SIDE SCRAPERS								-
END SCRAPERS						1		1
PROJECTILE PTS.			1					1
BIPOLAR SPLIT PEBBLES	23					2		25
CORES	7	6		1				14
HAMMERSTONES	2-1?						1?	4
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	41	9	1	1	-	3	1	56
#* = Platform (direct percussion) #x = Bipolar.								
Primary Decortication Flake	71-6*-3x	27-1x	2	2		2	2	116
Secondary Decortication Flake	117-20*-3x	3	1					149
Reduction Flake	106		4	10	1	2	1	124
Retouch Flake	78		7	2		1	1	89
Shatter	1004	403	9	9	1	8	37	1471
Spalls	1x							1
Other	10			3			1	14
Total Debitage	1419	439	23	26	2	13	42	1964
TOTAL LITHIC INDUSTRY	1460	448	24	27	2	16	43	2018

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	26	15			1		42

TABLE 14

LITHIC SUMMARY: FjPi-29

UNIT 2

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	3							3
CORES	4	2	1					7
HAMMERSTONES	5							5
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	12	2	1	–	–	–	–	16
#* = Platform (direct percussion) #x = Bipolar.								
Primary Decortication Flake	$4-3^{*}-2_{x}$	3						12
Secondary Decortication Flake	$16-6^{*}-1_{x}$							23
Reduction Flake	17	1	2					20
Retouch Flake	16							16
Shatter	58	12		1		1	3	75
Spalls								–
Other		1					1	2
Total Debitage	123	17	2	1	–	1	4	148
TOTAL LITHIC INDUSTRY	135	19	3	1	–	1	4	164

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	17	14	6				37

TABLE 15

LITHIC SUMMARY: FjPi-29

UNIT 3

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								
END SCRAPERS							1	1
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	3							3
CORES	2	2						4
HAMMERSTONES	6							6
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	12	2	-	-	-	-	1	15

#* = Platform (direct percussion) #x = Bipolar.

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake	4-1*-1x	2						8
Secondary Decortication Flake	2-7*							9
Reduction Flake	12						1	13
Retouch Flake	11							11
Shatter	43	9					6	58
Spalls	1x							1
Other	1		1				1	3
Total Debitage	83	11	1	-	-	-	8	102
TOTAL LITHIC INDUSTRY	95	13	1	-	-	-	9	117

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	9	7	4				20

TABLE 16

LITHIC SUMMARY: FjPi-29

UNIT 4

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.	1							1
BIFACES f.	4							4
UNIFACES c.	1							1
UNIFACES f.								-
EDGE MOD. FLAKES	3					1		4
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	1			1				2
CORES			1					1
HAMMERSTONES	4							4
ANVILS							1?	1
OTHER								-
TOTAL ARTIFACTS	14	-	1	1	-	1	1	18
$\#^{*}$ = Platform (direct percussion) $\#_{x}$ = Bipolar.								
Primary Decortication Flake	$3\text{-}1^{*}\text{-}3_{x}$	3					1	11
Secondary Decortication Flake	$16\text{-}3_{x}\text{-}6^{*}$			$1^{*}\text{-}2$		$2\text{-}1_{x}$		31
Reduction Flake	25			1	1	1		28
Retouch Flake	40					2		42
Shatter	175	28				2	5	210
Spalls								-
Other	2	2		2	1		2	9
Total Debitage	274	33	-	6	2	8	8	331
TOTAL LITHIC INDUSTRY	288	33	1	7	2	9	9	349

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	21	3	-	1	-	-	25

TABLE 17

LITHIC SUMMARY: FjPi-29

UNIT 5

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS						1		1
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	2							2
CORES	1							1
HAMMERSTONES	5							5
ANVILS	1							1
OTHER								-
TOTAL ARTIFACTS	10	-	-	-	-	1	-	11
#* = Platform (direct percussion) #x = Bipolar.								
Primary Decortication Flake	3					2x	1	6
Secondary Decortication Flake	7-2*							9
Reduction Flake	11							11
Retouch Flake	3		1					4
Shatter	39	11		1	3	4	3	61
Spalls								-
Other				1		1	2	4
Total Debitage	65	11	1	2	3	7	6	95
TOTAL LITHIC INDUSTRY	75	11	1	2	3	8	6	106

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1	1	1				3

TABLE 18

LITHIC SUMMARY: FjPi-29

UNIT 6

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES	4x	1x						5
HAMMERSTONES	1?						1?	2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	6	1	–	–	–	–	1	8
#* = Platform (direct percussion) #x = Bipolar.								
Primary Decortication Flake	5-1*-1x	2						9
Secondary Decortication Flake	6-15*-1x							22
Reduction Flake	23					1		24
Retouch Flake	10							10
Shatter	135	28		1		2	9	175
Spalls								–
Other								
Total Debitage	203	32	–	1	–	3	9	248
TOTAL LITHIC INDUSTRY	209	33	–	1	–	3	10	256

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	3	8					11

TABLE 19

LITHIC SUMMARY: FjPi-29

UNIT 7

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
#* = Platform (direct percussion) #* = Bipolar.								
Primary Decortication Flake	3-1-1							5
Secondary Decortication Flake	2-1							3
Reduction Flake	2			3			1	6
Retouch Flake								–
Shatter	18	7					1	26
Spalls								–
Other	2						2	4
Total Debitage	30	7	–	3	–	–	4	44
TOTAL LITHIC INDUSTRY	30	7	–	3	–	–	4	44

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	–	–	–	–	–	–	–

TABLE 20

LITHIC SUMMARY: FjPi-29

UNIT 8

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	2							2
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES	3_x-2?							5
HAMMERSTONES	1?							1
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	9	–	–	–	–	–	–	9
#* = Platform (direct percussion) $\#_x$ = Bipolar								
Primary Decortication Flake	4-2*	3					1*	10
Secondary Decortication Flake	2-3*							5
Reduction Flake	4							4
Retouch Flake	3							3
Shatter	25	16				1		42
Spalls								–
Other	1_x	5						6
Total Debitage	44	24	–	–	–	1	1	70
TOTAL LITHIC INDUSTRY	53	24	–	–	–	1	1	79

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	5	2					7

TABLE 21

LITHIC SUMMARY: FjPi-29

UNIT 9

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES				1				1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES	1							1
ANVILS								–
OTHER	1							1
TOTAL ARTIFACTS	2	–	–	1	–	–	–	3
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	4-3	2						9
Secondary Decortication Flake	10-4-1	1						16
Reduction Flake	13							13
Retouch Flake	16			1				17
Shatter	68	26				1	1	96
Spalls	3-1							4
Other	1	2					1	4
Total Debitage	124	31	–	1	–	1	2	159
TOTAL LITHIC INDUSTRY	126	31	–	2	–	1	2	162

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2	1		1			4

TABLE 22

LITHIC SUMMARY: FjPi-29

UNIT 10

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	3							3
SIDE SCRAPERS								–
END SCRAPERS						1		1
PROJECTILE PTS.		2						2
BIPOLAR SPLIT PEBBLES								–
CORES	1_x	3_x	1			2_x		7
HAMMERSTONES	1							1
ANVILS								–
OTHER				1				1
TOTAL ARTIFACTS	3	5	1	1	–	3	–	12
$\#^*$ = Platform (direct percussion) $\#_x$ = Bipolar.								
Primary Decortication Flake	5-5_x	4		1		1		16
Secondary Decortication Flake	17-8_x-8^*					1		34
Reduction Flake	35-6_x	1	3	2		1	1_x	49
Retouch Flake	18		3		2			23
Shatter	124	65				2	1	192
Spalls								–
Other	2	1	1	1		2	4	11
Total Debitage	224	71	7	4	2	7	6	325
TOTAL LITHIC INDUSTRY	227	76	8	5	2	10	6	337

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	3	2		1			6

TABLE 23

LITHIC SUMMARY: FjPi-29

UNIT 11

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES		1						1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES				2				2
CORES	1	5_{x}						6
HAMMERSTONES							1	1
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	6	–	2	–	–	1	10
$\#^{*}$ = Platform (direct percussion) $\#_{x}$ = Bipolar.								
Primary Decortication Flake	$5-3^{*}-1_{x}$	$3-1^{*}$				1_{x}		14
Secondary Decortication Flake	$17-3^{*}-2_{x}$					1_{x}		23
Reduction Flake	19-7		1	1				28
Retouch Flake	16		1					17
Shatter	105	53				1	1	160
Spalls								–
Other	2	3					1	6
Total Debitage	180	60	2	1	–	3	2	248
TOTAL LITHIC INDUSTRY	181	66	2	3	–	3	3	258

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2						2

TABLE 24

LITHIC SUMMARY: FjPi-29

UNIT 12

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES			2					2
HAMMERSTONES	2							2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	2	–	–	–	–	4
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1-1$_*$							2
Secondary Decortication Flake	4-4$_*$-3*	1*						12
Reduction Flake	13-1$_*$						1	15
Retouch Flake	1			1				2
Shatter	41	6					3	50
Spalls	1$_*$							1
Other		3				1	1	5
Total Debitage	70	10	–	1	–	1	5	87
TOTAL LITHIC INDUSTRY	72	10	2	1	–	1	5	91

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 25

LITHIC SUMMARY: FjPi-29

UNIT 13

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	2							2
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS						1		1
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1					1		2
CORES				2		1_{x}		3
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	3	–	–	2	–	3	–	8

$\#^{*}$ = Platform (direct percussion) $\#_{x}$ = Bipolar.

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake	$6-6^{*}-3_{x}$	5		1		$1-1^{*}$	1	24
Secondary Decortication Flake	$17-11^{*}-7_{x}$					1	1_{x}	37
Reduction Flake	$33-2_{x}$	$1-1_{x}$	3			1		41
Retouch Flake	16		1	1		5		23
Shatter	178	59		1		3	1	242
Spalls	$1-1_{x}$							2
Other	5	3-1						9
Total Debitage	286	70	4	3	–	12	3	378
TOTAL LITHIC INDUSTRY	289	70	4	5	–	15	3	386

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2						2

TABLE 26

LITHIC SUMMARY: FjPi-29

UNIT 14

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	5_x			1		2	1_x	9
CORES	1-4_x	1		1-1_x				8
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	10	1	–	3	–	2	1	17
	#* = Platform (direct percussion) $\#_x$ = Bipolar.							
Primary Decortication Flake	5-1_x	4						10
Secondary Decortication Flake	9-2*-3_x	1						15
Reduction Flake	20-3_x		1			2_x	1_x	27
Retouch Flake	6	1						7
Shatter	106	54			1		7	168
Spalls								–
Other	4	1				1	1	7
Total Debitage	159	61	1	–	1	3	9	234
TOTAL LITHIC INDUSTRY	169	62	1	3	1	5	10	251

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	1						1

TABLE 27

LITHIC SUMMARY: FjPi-29

UNIT 15

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	3							3
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	3	1				1		5
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.	1							1
BIPOLAR SPLIT PEBBLES	2					1		3
CORES	2_x	5_x		1_x				8
HAMMERSTONES	1						1	2
ANVILS								-
OTHER	1							1
TOTAL ARTIFACTS	13	6	-	1	-	2	1	23
#* = Platform (direct percussion) $\#_x$ = Bipolar.								
Primary Decortication Flake	$24-10_x$	$9-2_x$				1	1	47
Secondary Decortication Flake	$24-13_x-5^*$	1	1	1_x				45
Reduction Flake	$18-16_x$	$1-1_x$	2_x	1_x		2_x	1_x	32
Retouch Flake	35	1	4	1	1	3		45
Shatter	298	114	1	2		2	3	420
Spalls	1_x							1
Other	7	4		1		1		13
Total Debitage	451	133	8	6	1	9	5	603
TOTAL LITHIC INDUSTRY	464	139	8	7	1	11	6	626

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	8	3	2				13

TABLE 28

LITHIC SUMMARY: FjPi-29

UNIT 16

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	2					1_*		3
CORES	2_*							2
HAMMERSTONES	2?							2
ANVILS								–
OTHER							1	1
TOTAL ARTIFACTS	8	–	–	–	–	1	1	10
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar								
Primary Decortication Flake	9-6_*	2						17
Secondary Decortication Flake	9-6_*	1						16
Reduction Flake	9-12_*	1						22
Retouch Flake			1	1				2
Shatter	43	6			2		4	55
Spalls								–
Other	4	1					2	7
Total Debitage	98	10	1	2	2	–	6	119
TOTAL LITHIC INDUSTRY	106	10	1	2	2	1	7	129

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2	2					4

TABLE 29

LITHIC SUMMARY: FjPi-29

UNIT 17

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.	1							1
BIPOLAR SPLIT PEBBLES							1	1
CORES	1							1
HAMMERSTONES	3-1?							4
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	7	-	-	-	-	-	1	8
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	$6-3^*$							9
Secondary Decortication Flake	$13-5^*-2_x$							20
Reduction Flake	$10-2_x$		3	1				16
Retouch Flake	6							6
Shatter	108	24					20	152
Spalls	1							1
Other	2	3						5
Total Debitage	158	27	3	1	-	-	20	209
TOTAL LITHIC INDUSTRY	165	27	3	-	-	-	21	217

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	7						7

TABLE 30

LITHIC SUMMARY: FjPi-29

UNIT 18

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.	1							1
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	3-6$_*$							9
CORES	2-4$_*$			1-1$_*$				8
HAMMERSTONES							1	1
ANVILS								-
OTHER	1							1
TOTAL ARTIFACTS	19	-	-	2	-	-	1	22
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	6-4$_*$							10
Secondary Decortication Flake	5-2*							7
Reduction Flake	4							4
Retouch Flake								-
Shatter	6	4						10
Spalls	2$_*$-1							3
Other	6	1						7
Total Debitage	36	5	-	-	-	-	1	41
TOTAL LITHIC INDUSTRY	55	5	-	2	-	-	1	63

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	3	4					7

APPENDIX IV

LITHIC UNIT LEVEL SUMMARIES

TABLE 31

LITHIC SUMMARY: FjPi-29

UNIT 1A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	2							2
CORES							2	2
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	–	–	–	–	2	4
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	11	7				1	1	20
Secondary Decortication Flake	12-1*	3						16
Reduction Flake	5-2*			1	1	1	1	11
Retouch Flake	2			1				3
Shatter	31	11						42
Spalls								–
Other	1							1
Total Debitage	65	21	–	2	1	2	2	93
TOTAL LITHIC INDUSTRY	67	21	–	2	1	2	4	97

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 32

LITHIC SUMMARY: FjPi-29

UNIT 1B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								-
END SCRAPERS						1		1
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	2					1		3
CORES	1	1						2
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	4	1	-	-	-	2	-	7
#* = Platform (direct percussion) #* = Bipolar.								
Primary Decortication Flake	9	3-1*		1				15
Secondary Decortication Flake	12	1						13
Reduction Flake	19			4				23
Retouch Flake	2		1				1	4
Shatter	112	50	4					167
Spalls								-
Other	2							2
Total Debitage	156	55	5	5	-	-	2	223
TOTAL LITHIC INDUSTRY	160	56	5	5	-	2	2	230

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	3						3

TABLE 33

LITHIC SUMMARY: FjPi-29

UNIT 1C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	16							16
CORES	1							1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	17	–	–	–	–	–	–	17
#* = Platform (direct percussion) #* = Bipolar.								
Primary Decortication Flake	25	7				1	1	34
Secondary Decortication Flake	16	2						18
Reduction Flake	33		2	1				36
Retouch Flake	15		2					17
Shatter	233-1*	138			1		14	387
Spalls								–
Other								–
Total Debitage	323	147	4	1	1	1	15	492
TOTAL LITHIC INDUSTRY	340	147	4	1	1	1	15	509

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	3	2					5

TABLE 34

LITHIC SUMMARY: FjPi-29

UNIT 1D

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	3	2						5
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1					1		2
CORES	3	2						5
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	7	4	–	–	–	1	–	12
#* = Platform (direct percussion) #⁎ = Bipolar.								
Primary Decortication Flake	18-2*	5	1	1				27
Secondary Decortication Flake	45-7*-1⁎		1					54
Reduction Flake	22		2	4				28
Retouch Flake	25			1				26
Shatter	225	112		1		3	11	352
Spalls								–
Other				2				2
Total Debitage	344	117	4	9	–	3	11	489
TOTAL LITHIC INDUSTRY	451	121	4	9	–	4	11	501

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	7	5					12

TABLE 35

LITHIC SUMMARY: FjPi-29

UNIT 1E

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	2							2
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.			1					1
BIPOLAR SPLIT PEBBLES	2							2
CORES		1		1				2
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	5	1	1	1	–	–	–	8
$\#^{*}$ = Platform (percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	$5-1^{*}-1_{*}$	3	1					11
Secondary Decortication Flake	$20-2^{*}-5_{*}$	2						29
Reduction Flake	$8-1^{*}$							9
Retouch Flake	24					1		25
Shatter	230	59	3	6		5	4	307
Spalls	1_{*}							1
Other	1			1				2
Total Debitage	299	64	4	7	–	6	4	384
TOTAL LITHIC INDUSTRY	304	65	5	8	–	6	4	492

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	4	4					8

TABLE 36

LITHIC SUMMARY: FjPi-29

UNIT 1F

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.	1							1
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	2							2
HAMMERSTONES	2-1?						1?	4
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	6	–	–	–	–	–	1	7
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	2-3^*-1_*	2						8
Secondary Decortication Flake	12-7^*							19
Reduction Flake	13							13
Retouch Flake	6		3					9
Shatter	135	29	2	2			1	169
Spalls								–
Other	6						1	7
Total Debitage	185	31	5	2	–	–	2	225
TOTAL LITHIC INDUSTRY	191	31	5	2	–	–	3	232

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	8	4			1		13

TABLE 37

LITHIC SUMMARY: FjPi-29

UNIT 1G

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES		1						1
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES		2_x						2
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	-	3	-	-	-	-	-	3
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar								
Primary Decortication Flake	$1-1_x$							2
Secondary Decortication Flake								-
Reduction Flake	3					1		4
Retouch Flake	4		1					5
Shatter	37	4					7	48
Spalls								-
Other								-
Total Debitage	46	4	1	-	-	1	7	59
TOTAL LITHIC INDUSTRY	46	7	1	-	-	1	7	62

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	1						1

TABLE 38

LITHIC SUMMARY: FjPi-29

UNIT 2A

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	3							3
CORES	1	1	1					3
HAMMERSTONES	2							2
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	7	1	1	-	-	-	-	9
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	$3-2^{*}-1_{*}$	2						8
Secondary Decortication Flake	$15-4^{*}-1_{*}$							20
Reduction Flake	$12-2^{*}$	1	1					16
Retouch Flake	15							15
Shatter	47	12		1		1	2	63
Spalls								-
Other								-
Total Debitage	102	15	1	1	-	1	2	185
TOTAL LITHIC INDUSTRY	109	16	2	1	-	1	2	194

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	5	6	1				12

TABLE 39

LITHIC SUMMARY: FjPi-29

UNIT 2B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	2							2
HAMMERSTONES	2?							2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	4	–	–	–	–	–	–	4
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	$1-1^{*}-1_{*}$							3
Secondary Decortication Flake	1^{*}							1
Reduction Flake	3		1					4
Retouch Flake	1							1
Shatter	11						1	12
Spalls								–
Other							1	1
Total Debitage	19	–	1	–	–	–	2	22
TOTAL LITHIC INDUSTRY	23	–	1	–	–	–	2	30

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 40

LITHIC SUMMARY: FjPi-29

UNIT 2C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES		1						1
HAMMERSTONES	1							1
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	1	1	-	-	-	-	-	2
#* = Platform (direct percussion) #* = Bipolar.								
Primary Decortication Flake		1						1
Secondary Decortication Flake	1-1*							2
Reduction Flake								-
Retouch Flake								-
Shatter								-
Spalls								-
Other		1						1
Total Debitage	2	2	-	-	-	-	-	4
TOTAL LITHIC INDUSTRY	3	3	-	-	-	-	-	6

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	11	8	5				24

TABLE 41

LITHIC SUMMARY: FjPi-29

UNIT 4A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.	1							1
BIFACES f.	2-1?							3
UNIFACES c.	1							1
UNIFACES f.								-
EDGE MOD. FLAKES	2					1		3
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	1			1				2
CORES								-
HAMMERSTONES	2							2
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	10	-	-	1	-	1	-	12
	$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.							
Primary Decortication Flake	2-2_{x}	2						6
Secondary Decortication Flake	9-3_{x}-4^{x}			1^{x}-2		1-1_{x}		21
Reduction Flake	12				1			13
Retouch Flake	32					2		34
Shatter	100	20				2		122
Spalls						1		1
Other	2				1		1	4
Total Debitage	166	22	-	3	2	7	1	201
TOTAL LITHIC INDUSTRY	176	22	-	4	2	8	1	213

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	15			1			16

TABLE 42

LITHIC SUMMARY: FjPi-29

UNIT 4B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								-
END SCRAPERS								+
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES			1					1
HAMMERSTONES	2							2
ANVILS							1?	1
OTHER								-
TOTAL ARTIFACTS	4	-	1	-	-	-	1	6
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	$1-1^{*}-1_{*}$	1					1	5
Secondary Decortication Flake	$7-2^{*}$					1		10
Reduction Flake	13			1		1		15
Retouch Flake	18							18
Shatter	75	8					5	88
Spalls								-
Other		2		2			1	5
Total Debitage	118	11	-	3	-	2	7	141
TOTAL LITHIC INDUSTRY	122	11	1	3	-	2	8	147

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	6	3					9

TABLE 43

LITHIC SUMMARY: FjPi-29

UNIT 5A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	1							1
HAMMERSTONES	1							1
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	–	–	–	–	–	2

#* = Platform (direct percussion) $\#_*$ = Bipolar.

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake	1							1
Secondary Decortication Flake	1-1*							2
Reduction Flake	2							2
Retouch Flake			1					1
Shatter	21	10				2		33
Spalls								–
Other	1							1
Total Debitage	27	10	1	–	–	2	–	40
TOTAL LITHIC INDUSTRY	29	10	1	–	–	2	–	42

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 44

LITHIC SUMMARY: FjPi-29

UNIT 5B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	1							–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	2							2
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	3	–	–	–	–	–	–	3
#* = Platform (direct percussion) #* = Bipolar								
Primary Decortication Flake	2					2		4
Secondary Decortication Flake	3-1*							4
Reduction Flake	6							6
Retouch Flake	1							1
Shatter	13			1	2	2	1	19
Spalls								–
Other				1		1		2
Total Debitage	26	–	–	2	2	5	1	36
TOTAL LITHIC INDUSTRY	29	–	–	2	2	5	1	39

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces			1				1

TABLE 45

LITHIC SUMMARY: FjPi-29

UNIT 5C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS						1		1
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES	4							4
ANVILS	1							1
OTHER								–
TOTAL ARTIFACTS	5	–	–	–	–	1	–	6
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake							1	1
Secondary Decortication Flake	1							1
Reduction Flake	3							3
Retouch Flake	2							2
Shatter	5	1			1		2	9
Spalls								–
Other							2	2
Total Debitage	11	1	–	–	1	–	5	18
TOTAL LITHIC INDUSTRY	16	1	–	–	1	1	5	24

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces		1					1

TABLE 46

LITHIC SUMMARY: FjPi-29

UNIT 6A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
#* = Platform (direct percussion) #⁎ = Bipolar.								
Primary Decortication Flake	1–1*							2
Secondary Decortication Flake	5*–2							7
Reduction Flake	4							4
Retouch Flake	3							3
Shatter	32	7		1		1	2	43
Spalls								–
Other	3							3
Total Debitage	51	7	–	1	–	1	2	62
TOTAL LITHIC INDUSTRY	51	7	–	1	–	1	2	62

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	3						3

TABLE 47

LITHIC SUMMARY: FjPi-29

UNIT 6B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES	1_*	1						2
HAMMERSTONES								–
ANVILS							1	1
OTHER								–
TOTAL ARTIFACTS	2	1	–	–	–	–	1	4
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	$5-1_*$	2						8
Secondary Decortication Flake	$1-1_*-9^*$							11
Reduction Flake	14							14
Retouch Flake	7							7
Shatter	68	12				1		81
Spalls								–
Other	3	2						5
Total Debitage	109	16	–	–	–	1	–	126
TOTAL LITHIC INDUSTRY	111	17	–	–	–	1	1	130

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces		4					4

TABLE 48

LITHIC SUMMARY: FjPi-29

UNIT 6C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	3₊							3
HAMMERSTONES	1?						1?	2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	4	–	–	–	–	–	1	5

#* = Platform (direct percussion) #₊ = Bipolar.

Primary Decortication Flake								–
Secondary Decortication Flake	3-1*							4
Reduction Flake	5					1		6
Retouch Flake								–
Shatter	35	9					7	51
Spalls								–
Other								–
Total Debitage	46	9	–	–	–	1	7	61
TOTAL LITHIC INDUSTRY	50	9	–	–	–	1	8	66

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces		4					4

TABLE 49

LITHIC SUMMARY: FjPi-29

UNIT 7A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
#* = Platform (direct percussion) #⁎ = Bipolar.								
Primary Decortication Flake								–
Secondary Decortication Flake	1–1*							2
Reduction Flake								–
Retouch Flake								–
Shatter	7	2					1	10
Spalls								–
Other	2						2	4
Total Debitage	11	2	–	–	–	–	3	16
TOTAL LITHIC INDUSTRY	11	2	–	–	–	–	3	16

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces							–

TABLE 50

LITHIC SUMMARY: FjPi-29

UNIT 7B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	$3-1^*-1_*$							5
Secondary Decortication Flake	1							1
Reduction Flake	2			3			1	6
Retouch Flake								–
Shatter	11	5						16
Spalls								–
Other								–
Total Debitage	19	5	–	3	–	–	1	28
TOTAL LITHIC INDUSTRY	19	5	–	3	–	–	1	28

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 51

LITHIC SUMMARY: FjPi-29

UNIT 8A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS	1							1
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES	2x							2
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	3	-	-	-	-	-	-	3
#* = Platform (direct percussion) #x = Bipolar.								
Primary Decortication Flake	4-2x							6
Secondary Decortication Flake	1-3x							4
Reduction Flake								-
Retouch Flake	2							2
Shatter	17	15						32
Spalls								-
Other		3						3
Total Debitage	29	18	-	-	-	-	-	47
TOTAL LITHIC INDUSTRY	32	18	-	-	-	-	-	50

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	3	1					4

TABLE 52

LITHIC SUMMARY: FjPi-29

UNIT 8B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES	1							1
CORES	1_*-2_*?							3
HAMMERSTONES	1?							1
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	6	-	-	-	-	-	-	6
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake		3					1^*	4
Secondary Decortication Flake	1							1
Reduction Flake	3							3
Retouch Flake	1							1
Shatter	8	1				1		10
Spalls								-
Other	1_*	2						3
Total Debitage	14	6	-	-	-	1	1	22
TOTAL LITHIC INDUSTRY	20	6	-	-	-	1	1	28

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2	1					3

TABLE 53

LITHIC SUMMARY: FjPi-29

UNIT 8C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
#* = Platform (direct percussion) #* = Bipolar								
Primary Decortication Flake								–
Secondary Decortication Flake								–
Reduction Flake	1							1
Retouch Flake								–
Shatter								–
Spalls								–
Other								–
Total Debitage	1	–	–	–	–	–	–	1
TOTAL LITHIC INDUSTRY	1	–	–	–	–	–	–	1

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces							–

TABLE 54

LITHIC SUMMARY: FjPi-29

UNIT 9A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES				1				1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	1	–	–	–	1
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1^*							1
Secondary Decortication Flake	$3-2^*$							5
Reduction Flake	3							3
Retouch Flake	2							2
Shatter	11	5				1		17
Spalls								–
Other	1_*	1						2
Total Debitage	23	6	–	–	–	1	–	30
TOTAL LITHIC INDUSTRY	23	6	–	1	–	1	–	31

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 55

LITHIC SUMMARY: FjPi-29

UNIT 9B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES	1							1
ANVILS								–
OTHER	1							1
TOTAL ARTIFACTS	1	–	–	–	–	–	–	1
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	4							4
Secondary Decortication Flake	$7-1^*-1_*$							9
Reduction Flake	6							6
Retouch Flake	10							10
Shatter	35	21						56
Spalls	2							2
Other		1						1
Total Debitage	66	22	–	–	–	–	–	88
TOTAL LITHIC INDUSTRY	68	22	–	–	–	–	–	90

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1			1			2

TABLE 56

LITHIC SUMMARY: FjPi-29

UNIT 9C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	2_*	2						4
Secondary Decortication Flake	1^*	1						2
Reduction Flake	4							4
Retouch Flake	4			1				5
Shatter	22	4				1	1	28
Spalls	$1-1_*$							2
Other							1	1
Total Debitage	35	7	-	1	-	1	2	46
TOTAL LITHIC INDUSTRY	35	7	-	1	-	1	2	46

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1	1					2

TABLE 57

LITHIC SUMMARY: FjPi-29

UNIT 10A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES		1_*						1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	1	–	–	–	–	–	1
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake								–
Secondary Decortication Flake								–
Reduction Flake	$4-1_*$							5
Retouch Flake	1							1
Shatter	18	5				1		24
Spalls								–
Other								–
Total Debitage	24	5	–	–	–	1	–	34
TOTAL LITHIC INDUSTRY	24	6	–	–	–	1	–	35

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces							–

TABLE 58

LITHIC SUMMARY: FjPi-29

UNIT 10B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.		2						2
BIPOLAR SPLIT PEBBLES								–
CORES			1					1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	2	1	–	–	–	–	4
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	1-1$_x$	3		1				6
Secondary Decortication Flake	7-4^x-2$_x$					1		14
Reduction Flake	9-4$_x$			1		1	1$_x$	16
Retouch Flake	5		3					8
Shatter	43	28				1	1	73
Spalls								–
Other		1		1			3	5
Total Debitage	76	32	3	3	–	3	5	122
TOTAL LITHIC INDUSTRY	77	34	4	3	–	3	5	126

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	100.1	0 - 50mm	50.1-100mm	100.1	
# of Pieces	1			1			2

TABLE 59

LITHIC SUMMARY: FjPi-29

UNIT 10C

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	2							2
SIDE SCRAPERS								-
END SCRAPERS						1		1
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES	1_x	2_x				2_x		5
HAMMERSTONES	1							1
ANVILS								-
OTHER				1				1
TOTAL ARTIFACTS	5	2	-	1	-	3	-	11
$\#^{*}$ = Platform (direct percussion) $\#_{x}$ = Bipolar.								
Primary Decortication Flake	$4-4_x$					1		9
Secondary Decortication Flake	$8-4^{*}-4_x$							16
Reduction Flake	$11-1_x$	1	3	1				17
Retouch Flake	12				2			14
Shatter	53	24						77
Spalls								-
Other	1		1			2	1	5
Total Debitage	102	25	4	1	2	3	1	138
TOTAL LITHIC INDUSTRY	107	27	4	2	2	6	1	149

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	2	1					3

TABLE 60

LITHIC SUMMARY: FjPi-29

UNIT 10D

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES								-
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	-	-	-	-	-	-	-	-
#* = Platform (direct percussion) #$_*$ = Bipolar.								
Primary Decortication Flake		1						1
Secondary Decortication Flake	2-2$_x$							4
Reduction Flake	1$_x$							1
Retouch Flake								-
Shatter	9	8						17
Spalls								-
Other	1							1
Total Debitage	15	9	-	-	-	-	-	24
TOTAL LITHIC INDUSTRY	15	9	-	-	-	-	-	24

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces		1					1

TABLE 61

LITHIC SUMMARY: FjPi-29

UNIT 10E

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
	#* = Platform (direct percussion) #* = Bipolar.							
Primary Decortication Flake								–
Secondary Decortication Flake								–
Reduction Flake	1							1
Retouch Flake								–
Shatter	1							1
Spalls								–
Other								–
Total Debitage	2	–	–	–	–	–	–	2
TOTAL LITHIC INDUSTRY	2	–	–	–	–	–	–	2

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces							–

TABLE 62

LITHIC SUMMARY: FjPi-29

UNIT 11A

CATEGORY	Quart-zite	Silicified wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES		1						1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	1	–	–	–	–	–	1
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake								–
Secondary Decortication Flake	$1-1^{x}$							2
Reduction Flake	$6-2_{x}$		1	1				10
Retouch Flake	4							4
Shatter	36	21						57
Spalls								–
Other		2						2
Total Debitage	50	23	1	1	–	–	–	75
TOTAL LITHIC INDUSTRY	50	24	1	1	–	–	–	75

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 63

LITHIC SUMMARY: FjPi-29

UNIT 11B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES				1				1
CORES		3_x						3
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	3	–	1	–	–	–	4
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	$3-1^x-1_x$	$3-1^x$				1_x		10
Secondary Decortication Flake	$6-2^x$					1^x		9
Reduction Flake	$5-4_x$							9
Retouch Flake	9		1					10
Shatter	46	22				1	1	70
Spalls								–
Other	2	1					1	4
Total Debitage	79	27	1	–	–	3	2	112
TOTAL LITHIC INDUSTRY	70	30	1	1	–	3	2	116

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 64

LITHIC SUMMARY: FjPi-29

UNIT 11C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES				1				-
CORES	1	2_{x}						3
HAMMERSTONES							1	1
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	1	2	-	1	-	-	1	5

$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.

Primary Decortication Flake	$2-2^{x}$							4
Secondary Decortication Flake	$5-1^{x}$							6
Reduction Flake	$8-1_{x}$							9
Retouch Flake	3							3
Shatter	23	10						33
Spalls								-
Other								-
Total Debitage	45	10	-	-	-	-	-	55
TOTAL LITHIC INDUSTRY	46	12	-	1	-	-	1	60

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							-

TABLE 65

LITHIC SUMMARY: FjPi-29

UNIT 12A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
#* = Platform (direct percussion) #* = Bipolar.								
Primary Decortication Flake								–
Secondary Decortication Flake								–
Reduction Flake	3							3
Retouch Flake	1							1
Shatter	3							3
Spalls								–
Other								–
Total Debitage	7	–	–	–	–	–	–	7
TOTAL LITHIC INDUSTRY	7	–	–	–	–	–	–	7

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 66

LITHIC SUMMARY: FjPi-29

UNIT 12B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES				1				1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	1	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1_x							1
Secondary Decortication Flake	$1-1^x$							2
Reduction Flake	$4-1_x$							5
Retouch Flake								–
Shatter	17	4						21
Spalls								–
Other		1						1
Total Debitage	25	5	–	–	–	–	–	30
TOTAL LITHIC INDUSTRY	25	5	–	1	–	–	–	31

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 67

LITHIC SUMMARY: FjPi-29

UNIT 12C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES			1					1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	1	–	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1							1
Secondary Decortication Flake	2-2$_*$-1*							5
Reduction Flake	2							2
Retouch Flake				1				1
Shatter	16						2	18
Spalls	1$_*$							1
Other		2						2
Total Debitage	25	2	–	1	–	–	2	30
TOTAL LITHIC INDUSTRY	25	2	1	1	–	–	2	31

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 68

LITHIC SUMMARY: FjPi-29

UNIT 12D

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES								-
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	-	-	-	-	-	-	-	-
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake								-
Secondary Decortication Flake	$1-1^{x}-1_{x}$	1^{x}						4
Reduction Flake	3						1	4
Retouch Flake								-
Shatter	5	2					1	8
Spalls								-
Other						1	1	2
Total Debitage	11	3	-	-	-	1	3	18
TOTAL LITHIC INDUSTRY	11	3	-	-	-	1	3	18

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							-

TABLE 70

LITHIC SUMMARY: FjPi-29

UNIT 12E

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES	2							2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	–	–	–	–	–	2
#* = Platform (direct percussion) #$_*$ = Bipolar.								
Primary Decortication Flake								–
Secondary Decortication Flake	1x							1
Reduction Flake	1							1
Retouch Flake								–
Shatter								–
Spalls								–
Other								–
Total Debitage	2	–	–	–	–	–	–	2
TOTAL LITHIC INDUSTRY	4	–	–	–	–	–	–	4

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 71

LITHIC SUMMARY: FjPi-29

UNIT 13A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES				1				1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	1	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake		2					1	3
Secondary Decortication Flake	$3-1_x$							4
Reduction Flake	14	1_x						15
Retouch Flake	2					2		4
Shatter	42	20						62
Spalls								–
Other		$1-1_x$						2
Total Debitage	62	25	–	–	–	2	1	90
TOTAL LITHIC INDUSTRY	62	25	–	1	–	2	1	91

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 72

LITHIC SUMMARY: FjPi-29

UNIT 13B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1?							1
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES								-
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES						1		1
CORES								-
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	1	-	-	-	-	1	-	2
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	$1-1^{*}$	2		1		$1-1^{*}$		7
Secondary Decortication Flake	$8-7^{*}-2_{*}$							17
Reduction Flake	9		1					10
Retouch Flake	8		1	1		1		11
Shatter	46	14		1		3		64
Spalls	1							1
Other	1	2						3
Total Debitage	84	18	2	3	-	6	-	113
TOTAL LITHIC INDUSTRY	85	18	2	3	-	7	-	115

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	2						2

TABLE 73

LITHIC SUMMARY: FjPi-29

UNIT 13C

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS						1		1
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES				1		1_x		2
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	–	1	–	2	–	5

$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake	$5-3_x-2^x$	1						11
Secondary Decortication Flake	$5-4^x-4_x$						1_x	14
Reduction Flake	$10-2_x$	1	2			1		16
Retouch Flake	6					2		8
Shatter	80	24					1	105
Spalls	1_x							1
Other	4							4
Total Debitage	126	26	2	–	–	3	2	159
TOTAL LITHIC INDUSTRY	128	26	2	1	–	5	2	164

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 74

LITHIC SUMMARY: FjPi-29

UNIT 13D

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1_*							1
Secondary Decortication Flake	2^*							2
Reduction Flake	1					1		2
Retouch Flake								–
Shatter	10	1						11
Spalls								–
Other								–
Total Debitage	14	1	–	–	–	1	–	16
TOTAL LITHIC INDUSTRY	14	1	–	–	–	1	–	16

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 75

LITHIC SUMMARY: FjPi-29

UNIT 14A

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES						1		1
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	1	–	1
$\#^*$ = Platform (direct percussion) $\#_*$ = Bipolar.								
Primary Decortication Flake	1							1
Secondary Decortication Flake	3							3
Reduction Flake	2							2
Retouch Flake								–
Shatter	41	9						50
Spalls								–
Other								–
Total Debitage	46	9	–	–	–	–	–	56
TOTAL LITHIC INDUSTRY	46	9	–	–	–	–	–	57

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 76

LITHIC SUMMARY: FjPi-29

UNIT 14B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES				1				1
CORES		1						1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	1	–	1	–	–	–	2
$\#^{*}$ = Platform (direct percussion) $\#_{*}$ = Bipolar.								
Primary Decortication Flake	1_{*}							1
Secondary Decortication Flake	$2-1^{*}$	1						3
Reduction Flake	$5-1_{*}-1^{*}$						1_{*}	8
Retouch Flake	3							3
Shatter	37	31					1	69
Spalls								–
Other		1						1
Total Debitage	51	33	–	–	–	–	2	85
TOTAL LITHIC INDUSTRY	51	34	–	1	–	–	2	87

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 77

LITHIC SUMMARY: FjPi-29

UNIT 14C

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1						1	2
CORES	1			1				2
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	–	–	1	–	–	1	4
#* = Platform (direct percussion). #x = Bipolar.								
Primary Decortication Flake	2	2						4
Secondary Decortication Flake	3-2-1							6
Reduction Flake	4							4
Retouch Flake								–
Shatter	16	7			1		6	30
Spalls								–
Other		1					1	2
Total Debitage	28	10	–	–	1	–	7	46
TOTAL LITHIC INDUSTRY	30	10	–	1	1	–	8	50

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 78

LITHIC SUMMARY: FjPi-29

UNIT 14D

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	4_x					1		5
CORES	1-2_x			1_x				4
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	7	–	–	1	–	1	–	9
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	2	2						4
Secondary Decortication Flake	1							1
Reduction Flake	4-3_x-1^x		1			2_x		11
Retouch Flake	3							3
Shatter	10	5						15
Spalls								–
Other	4					1		5
Total Debitage	28	7	1	1	–	3	–	39
TOTAL LITHIC INDUSTRY	35	7	1	1	–	4	–	48

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 79

LITHIC SUMMARY: FjPi-29

UNIT 14E

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	1_x							1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	–	–	–	–	–	–	1

$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake								–
Secondary Decortication Flake	1_x							1
Reduction Flake	2							2
Retouch Flake								–
Shatter	2	2						4
Spalls								–
Other								–
Total Debitage	5	2	–	–	–	–	–	7
TOTAL LITHIC INDUSTRY	6	2	–	–	–	–	–	8

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 80

LITHIC SUMMARY: FjPi-29

UNIT 15A

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	1_x	1_x		1_x				3
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	1	–	1	–	–	–	3

$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.

	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
Primary Decortication Flake	4	3						7
Secondary Decortication Flake	1^x-2							3
Reduction Flake	1_x-2							3
Retouch Flake	4		1	1		1		7
Shatter	28	15	1				1	45
Spalls								–
Other	1							1
Total Debitage	43	18	2	1	–	1	1	66
TOTAL LITHIC INDUSTRY	44	19	2	2	–	1	1	69

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 81

LITHIC SUMMARY: FjPi-29

UNIT 15B

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.	1_x							-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.	1							1
BIPOLAR SPLIT PEBBLES	1					1_x		2
CORES		2_x						2
HAMMERSTONES								-
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	4	2	-	-	-	1	-	7
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	$5-4_x$	$4-1_x$				1		15
Secondary Decortication Flake	$5-3^x-2_x$							10
Reduction Flake	$5-2_x$			1_x				8
Retouch Flake	10							10
Shatter	97	44		2				143
Spalls								-
Other	3					1		4
Total Debitage	136	49	-	3	-	2	-	190
TOTAL LITHIC INDUSTRY	140	51	-	3	-	3	-	197

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 82

LITHIC SUMMARY: FjPi-29

UNIT 15C

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES		1						1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	1_x							1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	2	1	–	–	–	–	–	3
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	$5-3_x$	$1-1_x$						10
Secondary Decortication Flake	$8-3_x$		1					12
Reduction Flake	$3-4_x$					1_x	1_x	9
Retouch Flake	4		1					5
Shatter	68	25				1		91
Spalls								–
Other	1	2						3
Total Debitage	99	29	2	–	–	2	1	130
TOTAL LITHIC INDUSTRY	101	30	2	–	–	2	1	133

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces	1		1				2

TABLE 83

LITHIC SUMMARY: FjPi-29

UNIT 15D

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER	1							–
TOTAL ARTIFACTS	3	–	–	–	–	–	–	3
#* = Platform (direct percussion). #x = Bipolar.								
Primary Decortication Flake	2	1						3
Secondary Decortication Flake	2-1-2							5
Reduction Flake	2-2		1			1		6
Retouch Flake	5	1				1		7
Shatter	39	7				1		47
Spalls								–
Other	1	2						3
Total Debitage	56	11	1	–	–	3	–	71
TOTAL LITHIC INDUSTRY	59	11	1	–	–	3	–	74

Fire Broken/cracked rock Size	Quartzite 0 - 50mm	Quartzite 50.1-100mm	Quartzite >100.1	Non-Quartzite 0 - 50mm	Non-Quartzite 50.1-100mm	Non-Quartzite >100.1	Total
# of Pieces		2					2

TABLE 84

LITHIC SUMMARY: FjPi-29

UNIT 15E

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES		1_x						1
HAMMERSTONES							1	1
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	1	–	–	–	–	–	3
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	3-2_x						1	6
Secondary Decortication Flake	3-4_x	1		1_x				9
Reduction Flake	6-4_x	1-1_x	1_x					13
Retouch Flake	6		1		1	1		9
Shatter	40	13					2	55
Spalls								–
Other	1			1				2
Total Debitage	69	16	2	2	1	1	3	94
TOTAL LITHIC INDUSTRY	70	17	2	2	1	1	4	97

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	3						3

TABLE 85

LITHIC SUMMARY: FjPi-29

UNIT 15F

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								-
BIFACES f.								-
UNIFACES c.								-
UNIFACES f.								-
EDGE MOD. FLAKES	1					1		2
SIDE SCRAPERS								-
END SCRAPERS								-
PROJECTILE PTS.								-
BIPOLAR SPLIT PEBBLES								-
CORES		1_x						1
HAMMERSTONES	1							1
ANVILS								-
OTHER								-
TOTAL ARTIFACTS	2	1	-	-	-	1	-	4
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	$5-1_x$							6
Secondary Decortication Flake	$4-2_x$							6
Reduction Flake	5							5
Retouch Flake	6		1					7
Shatter	26	10						36
Spalls	1_x							1
Other								-
Total Debitage	50	10	1	-	-	-	-	61
TOTAL LITHIC INDUSTRY	52	11	1	-	-	1	-	65

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	3	1	1				5

TABLE 86

LITHIC SUMMARY: FjPi-29

UNIT 16A

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	1							1
Secondary Decortication Flake	$1-1_x$							2
Reduction Flake	$1-1_x$							2
Retouch Flake								–
Shatter	2							2
Spalls								–
Other								–
Total Debitage	7	–	–	–	–	–	–	7
TOTAL LITHIC INDUSTRY	7	–	–	–	–	–	–	7

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 87

LITHIC SUMMARY: FjPi-29

UNIT 16B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER							1 *	1
TOTAL ARTIFACTS	1	–	–	–	–	–	1	2
#ˣ = Platform (direct percussion). #ₓ = Bipolar.								
Primary Decortication Flake	4-3ₓ							7
Secondary Decortication Flake	4-1ₓ							5
Reduction Flake	4-1ₓ							5
Retouch Flake			1					1
Shatter	8	2						10
Spalls								–
Other	2						1	3
Total Debitage	27	2	1	–	–	–	1	31
TOTAL LITHIC INDUSTRY	28	2	1	–	–	–	2	33

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

* = .22 calibre rimfire cartridge.

TABLE 88

LITHIC SUMMARY: FjPi-29

UNIT 16C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES	1							1
CORES	1_x							1
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	3	–	–	–	–	–	–	3
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	1_x	1						2
Secondary Decortication Flake	$1-1_x$							2
Reduction Flake	$1-3_x$							4
Retouch Flake								–
Shatter	14	3			2		2	21
Spalls								–
Other		1						1
Total Debitage	21	5	–	–	2	–	2	30
TOTAL LITHIC INDUSTRY	24	5	–	–	2	–	2	33

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

TABLE 89

LITHIC SUMMARY: FjPi-29

UNIT 16D

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	–	–	–	–	–	–	–	–
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	3	1						4
Secondary Decortication Flake	1–2_x	1						4
Reduction Flake	6							6
Retouch Flake				1				1
Shatter	19	1					2	22
Spalls								–
Other	1						1	2
Total Debitage	32	3	–	1	–	–	3	39
TOTAL LITHIC INDUSTRY	32	3	–	1	–	–	3	39

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1	1					2

TABLE 90

LITHIC SUMMARY: FjPi-29

UNIT 16E

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES	1							1
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES						1_x		1
CORES	1_x							1
HAMMERSTONES	2?							2
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	4	–	–	–	–	1	–	5
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	2_x							2
Secondary Decortication Flake	$2-1_x$							3
Reduction Flake	$3-2_x$			1				6
Retouch Flake								–
Shatter								–
Spalls								–
Other	1							1
Total Debitage	11	–	–	1	–	–	–	12
TOTAL LITHIC INDUSTRY	15	–	–	1	–	1	–	17

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1	1					2

TABLE 91

LITHIC SUMMARY: FjPi-29

UNIT 17A

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.	1							1
BIPOLAR SPLIT PEBBLES							1	1
CORES								–
HAMMERSTONES								–
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	–	–	–	–	–	1	2
$\#^x$ = Platform (direct percussion). $\#_x$ = Bipolar.								
Primary Decortication Flake	4							4
Secondary Decortication Flake	4-3^x-1_x							8
Reduction Flake	5-1_x			1				7
Retouch Flake	3							3
Shatter	37	6					7	50
Spalls								–
Other								–
Total Debitage	58	6	–	1	–	–	7	72
TOTAL LITHIC INDUSTRY	59	6	–	1	–	–	8	74

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	1						1

TABLE 92

LITHIC SUMMARY: FjPi-29

UNIT 17B

CATEGORY	Quartzite	Silicified wood	Chalcedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.	1							1
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES	1							1
HAMMERSTONES	2-1							3
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	5	–	–	–	–	–	–	5
$\#^{x}$ = Platform (direct percussion). $\#_{x}$ = Bipolar.								
Primary Decortication Flake	$2-2^{x}$							4
Secondary Decortication Flake	$8-2^{x}-1_{x}$							11
Reduction Flake	$4-1_{x}$		3					8
Retouch Flake	3							3
Shatter	66	17					8	91
Spalls	1							1
Other	1	3						4
Total Debitage	91	20	3	–	–	–	8	122
TOTAL LITHIC INDUSTRY	96	20	3	–	–	–	8	127

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces	6						6

TABLE 93

LITHIC SUMMARY: FjPi-29

UNIT 17C

CATEGORY	Quart-zite	Silici-fied wood	Chal-cedony	Chert	Quartz	Mudstone	Other	Total
BIFACES c.								–
BIFACES f.								–
UNIFACES c.								–
UNIFACES f.								–
EDGE MOD. FLAKES								–
SIDE SCRAPERS								–
END SCRAPERS								–
PROJECTILE PTS.								–
BIPOLAR SPLIT PEBBLES								–
CORES								–
HAMMERSTONES	1							1
ANVILS								–
OTHER								–
TOTAL ARTIFACTS	1	–	–	–	–	–	–	1
#* = Platform (direct percussion). #x = Bipolar.								
Primary Decortication Flake	1*							1
Secondary Decortication Flake	1							1
Reduction Flake	1							1
Retouch Flake								–
Shatter	5	1					5	11
Spalls								–
Other	1							1
Total Debitage	9	1	–	–	–	–	5	15
TOTAL LITHIC INDUSTRY	10	1	–	–	–	–	5	16

Fire Broken/cracked rock	Quartzite			Non-Quartzite			Total
Size	0 - 50mm	50.1-100mm	>100.1	0 - 50mm	50.1-100mm	>100.1	
# of Pieces							–

APPENDIX V

BULK SAMPLE RESULTS
(5% Samples)

UNIT	LEVEL	ARTIFACT DESCRIPTION	# > 0.5 cm	# < 0.5 cm
5	A	Quarzite flake	1	-
5	B	Chert flake	1	-
6	A	Quartzite shatter	2	-
6	B	Primary decortication quartzite flake	1	-
6	B	Quartzite shatter	2	1
6	C	Quartzite split pebble	1	-
7	A	Bone fragment	1	-
7	A	Split pebble fragment	1	-
8	A	Petrified wood fragment	1	-
8	A	Quartzite shatter	1	-
8	A	Bone fragments	3	1
9	A	Quartzite retouch flakes	1	1
9	A	Quartzite shatter	1	-
9	A	Mudstone shatter	1	-
9	A	Bone fragments	-	2
9	B	Quartzite flake	1	-
9	B	Petrified wood shatter	1	-
9	C	Quartzite secondary decortication flake	1	-
9	C	Quartzite retouch flake	-	1
10	A	Quartzite fire-cracked rock	1	-
10	A	Quartzite shatter	2	1
10	A	Quartzite flake	1	1
10	A	Petrified wood shatter	1	-
10	B	Quartzite shatter	-	11
10	B	Quartzite retouch flake	1	-
10	B	Chert shatter	1	-
10	B	Bone fragments	4	2
10	C	Quartzite shatter	3	9
10	C	Quartzite secondary decortication flake	3	-
10	C	Quartzite retouch flake	1	-
10	C	Petrified wood shatter	2	-
10	C	Bone fragments	4	3
10	D	Petrified wood shatter	1	-
11	A	Quartzite secondary decortication flake	3	-
11	A	Quartzite reduction flake	2	-
11	A	Petrified wood shatter	1	1
11	A	Bone fragments	1	2
11	B	Quartzite shatter	2	10
11	B	Petified wood shatter	-	5
11	C	Quartzite shatter	1	1
11	C	Quartzite Uniface	1	-
12	B	Quartzite shatter	1	1

UNIT	LEVEL	ARTIFACT DESCRIPTION	# > 0.5 cm	# < 0.5 cm
12	B	Bone fragments	2	2
12	C	Bone fragment	-	1
12	D	Quartzite primary decortication flake	1	-
12	D	Quartzite retouch flake	-	1
12	E	Quartzite shatter	-	1
13	A	Quartzite shatter	-	1
13	A	Petrified wood shatter	-	1
13	A	Bone fragment	-	1
13	B	Quartzite secondary decortication F.	1	-
13	B	Quartzite shatter	4	7
13	B	Petrified wood shatter	3	5
13	B	Bone fragments	-	3
13	C	Quartzite shatter	1	2
13	C	Bone fragments	1	4
15	A	Quartzite primary decortication flake	1	-
15	A	Quartzite shatter	1	3
15	A	Bone fragments	-	4
15	B	Quartzite shatter	4	4
15	B	Quartzite retouch flake	-	1
15	B	Bone fragments	-	1
15	C	Quartzite shatter	3	1
15	C	Petrified wood shatter	1	-
15	D	Quartzite shatter	1	-
15	D	Quartzite retouch flake	1	-
15	D	Mudstone shatter	1	-
15	D	Bone fragment	1	-
16	E	Quartzite shatter	2	-
17	B	Quartzite shatter	2	-
17	B	Quartzite retouch flake	1	-
		Total	94	98

Ratio: $\frac{>.5 \text{ cm}}{<.5 \text{ cm}} = .96$

$<$0.5 cm diagnostic flakes = 5

$\therefore$ Estimated recovery error = 5/98 = 5.0%
(with 0.5 cm screen mesh)

It is estimated that approximately 5.0% diagnostic flakes are not recovered if only a 0.5 cm mesh screen is used.

APPENDIX VI

PEARSON'S CORRELATION COEFFICIENTS

TABLE 94

MULTIPLATFORM CORE TO BIPOLAR CORE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
A	L	4	5	16	25	20
B	E	1	2	1	4	2
C	V	4	7	16	49	28
D	E	3	2	9	4	6
E	L	-	2	-	4	-
F		-	-	-	-	-
Total		12	18	42	94	56

$$r = \frac{n\Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\Sigma X^2 - (\Sigma X)^2}\ \sqrt{n\Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{120}{159.9}$$

$$r = .75$$

X = Multiplatform Cores

Y = Bipolar cores

TABLE 95

REDUCTION FLAKES - DECORTICATION FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
LEVEL	A	70	109	4900	11881	7630
	B	145	244	21025	59536	35380
	C	75	130	5625	16900	9750
	D	14	20	196	400	280
	E	13	8	169	64	104
	F	5	9	25	81	45
Total		322	520	31940	88862	53189

$$r = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{n\Sigma X^2 - (\Sigma X)^2}\sqrt{n\Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{151694}{152037.2}$$

$$r = .99$$

X = Reduction Flakes

Y = Decortication Flakes

TABLE 96

REDUCTION FLAKES - PRESSURE FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	90	35	8100	1225	3150
E	B	157	109	14649	11881	17113
V	C	110	57	12100	3249	6270
E	D	37	15	1369	225	555
L	E	21	9	441	81	189
	F	5	7	25	49	35
Total		420	232	46684	16710	27312

$$r = \frac{n\,\Sigma XY - (\Sigma X)\,(\Sigma Y)}{\sqrt{n\,\Sigma X^2 - (\Sigma X)^2}\sqrt{n\,\Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{66432}{69391}$$

$$r = .96$$

X = Reduction Flakes

Y = Pressure Flakes

TABLE 97

PRESSURE FLAKE - DECORTICATION FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
	A	35	132	1125	17424	4620
L	B	109	306	11881	93636	33354
E	C	57	183	3249	33489	10431
V	D	15	35	225	1225	525
E	E	9	22	81	484	198
L	F	7	12	49	194	84
Total		232	690	16710	146402	49212

$$r = \frac{n\ \Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\ \Sigma X^2 - (\Sigma X)^2}\ \sqrt{n\ \Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{135192}{136691.7}$$

$$r = .99$$

X = Pressure Flakes

Y = Decortication Flakes

TABLE 98

QUARTZITE - PETRIFIED WOOD CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	672	209	451584	43681	140448
E	B	1619	523	2621161	273529	846737
V	C	1068	226	1140624	51076	241368
E	D	205	41	42025	1681	8405
L	E	97	19	9409	361	1843
	F	52	11	2704	121	572
Total		3713	1029	4267507	370449	1239373

$$r = \frac{n\ \Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\ \Sigma X^2 - (\Sigma X)^2}\ \sqrt{n\ \Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{3615561}{3708698.6}$$

$$r = .97$$

X = Quartzite

Y = Petrified Wood

TABLE 99

VITREOUS MATERIALS - QUARTZITE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	672	27	451584	729	18144
E	B	1619	63	2621161	3969	101997
V	C	1068	45	1140624	2025	48060
E	D	205	12	42025	144	2460
L	E	97	6	9409	36	582
	F	52	1	2704	1	52
Total		3713	154	4267507	6904	171295

$$r = \frac{n\ \Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\ \Sigma X^2 - (\Sigma X)^2}\ \sqrt{n\ \Sigma Y^2 - (\Sigma Y^2)}}$$

$$r = \frac{455968}{457571.2}$$

$$r = .99$$

X = Quartzite

Y = Vitreous Materials

TABLE 100

PETRIFIED WOOD - VITREOUS MATERIAL CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	209	27	43681	729	5643
E	B	523	63	273529	3969	32949
V	C	226	45	51076	2025	10170
E	D	41	12	1681	144	492
L	E	19	6	361	36	114
	F	11	1	121	1	11
Total		1029	154	370449	6904	49379

$$r = \frac{n\ \Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\ \Sigma X^2 - (\Sigma X^2)}\ \sqrt{n\ \Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{137808}{143588.3}$$

$$r = .96$$

X = Petrified Wood

Y = Vitreous Materials

TABLE 101

VITREOUS PRESSURE FLAKE - TOTAL PRESSURE FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	8	18	64	324	144
E	B	11	47	121	2209	517
V	C	11	23	121	529	253
E	D	4	10	16	100	4
L	E	3	6	9	36	18
S	F	1	1	1	1	1
Total		37	105	332	3199	937

$$r = \frac{n\ \Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{n\ \Sigma X^2 - (\Sigma X)^2}\ \sqrt{n\ \Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{1737}{2260}$$

$$r = .77$$

X = Vitreous Material

Y = Total Pressure Flakes

TABLE 102

QUARTZITE PRESSURE FLAKE - TOTAL PRESSURE FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	27	188	729	35344	5076
E	B	112	197	12544	38809	22064
V	C	61	265	3721	70225	16165
E	D	12	45	144	2025	540
L	E	6	29	36	841	174
	F	6	20	36	1296	120
Total		224	744	17210	148540	44139

$$r = \frac{n\,\Sigma XY - (\Sigma X)\,(\Sigma Y)}{\sqrt{n\,\Sigma X^2 - (\Sigma X)^2}\sqrt{n\,\Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{98178}{186707.4}$$

$$r = .55$$

X = Quartzite

Y = Total Pressure Flakes

TABLE 103

QUARTZITE PRESSURE FLAKE - VITREOUS PRESSURE FLAKE CORRELATIONS

VARIABLES		X	Y	X^2	Y^2	XY
L	A	27	8	729	69	216
E	B	112	11	12544	121	1232
V	C	61	11	3721	121	671
E	D	12	4	144	16	48
L	E	6	3	36	9	18
	F	6	1	36	1	6
Total		224	37	17210	332	2191

$$r = \frac{n \, \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{n \, \Sigma X^2 - (\Sigma X)^2} \sqrt{n \, \Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{4858}{5760}$$

$$r = .84$$

X = Quartzite Pressure Flakes

Y = Vitreous Pressure Flakes

TABLE 104

VITREOUS - QUARTZITE ARTIFACT CLASSES

	VARIABLES	X	Y	X^2	Y^2	XY
ARTIFACTS	Cores	.42	.43	.1764	.1849	.1806
	P.D. Flakes	.42	.17	.1764	.0289	.0714
	S.D. Flakes	.12	.32	.0144	.1024	.0384
	Reduction F.	.28	.31	.0784	.0961	.0868
	Retouch F.	.20	.20	.0400	.0400	.0400
	Total	1.44	1.43	.4856	.4523	.4172

$$r = \frac{n\,\Sigma XY - (\Sigma X)\,(\Sigma Y)}{\sqrt{n\,\Sigma X^2 - (\Sigma X)^2}\,\sqrt{n\,\Sigma Y^2 - (\Sigma Y)^2}}$$

$$r = \frac{.0268}{.2770614}$$

$$r = .10$$

X = Vitreous Artifacts

Y = Quartzite Artifacts

APPENDIX VII

ARTIFACT METRICS

TABLE 105

PROJECTILE POINT METRICS

CATALOGUE #	DESCRIPTION	MEASUREMENTS (MM) L.	B.	T.	BASAL WIDTH
FjPi-29-12C-30	P. Wood, Avonlea. Complete	21	12	20	13.5
FjPi-29-1E-1	Chal. Pelican Lake Frag.	16	16	3.5	12.0
FjPi-29-10C-53	P. Wood, preform. Complete	28	23	6.0	16.0
FjPi-29-10B-18	P. Wood basal frag.	15	21	5.0	18.0
FjPi-29-1E-83	Quartz frag.	20	21	4.0	21.0
FjPi-29-15B-24	Quartzite frag.	26	21	4.0	21.0

TABLE 106

UNIFACE AND BIFACE METRICS

CATALOGUE #	DESCRIPTION	MEASUREMENTS (MM) L.	B.	T.	T/B
FjPi-29-15C-63	Q. Uniface cortex	90.0	62.0	15.0	.24
FjPi-29-11C	Q. Uniface cortex	80.0	73.0	23.0	.32
FjPi-29-15F-19	Q. Uniface cortex	57.0	48.0	11.0	.23
FjPi-29-2A-31	Q. Biface chopper, cortex	124.0	98.0	22.0	.22
FjPi-29 (surface)	Q. Biface complete	95.0	72.0	14.0	.19
FjPi-29-4A-29	Q. Blank complete	95.0	52.0	12.0	.23
FjPi-29-1F-29	Q. Biface frag.	55.0	72.0	22.0	.31
FjPi-29-1E-55	Q. Biface frag.	90.0	99.0	40.0	.40
FjPi-29-4A-46	Q. Biface frag.	50.0	106.0	21.0	.20
FjPi-29-15E-37	Q. Biface frag.	60.0	66.0	15.0	.23
FjPi-29-17B-39	Q. Biface Frag.	60.0	57.0	16.0	.28
FjPi-29-3A-21	Q. Biface Frag.	40.0	58.0	10.0	.17
FjPi-29-14D-28	Q. Biface frag.	37.0	65.0	14.0	.22
FjPi-29-16C-10	Q. Biface frag.	42.0	68.0	18.0	.26

TABLE 107

SCRAPER METRICS

CATALOGUE #	DESCRIPTION	MEASUREMENTS (MM) L.	B.	T.	EDGE ANGLE
FjPi-29-5C-6	Mudstone Side S.	65	40	10	-
FjPi-29-1B-17	Cal. Mudstone End Scraper	17	20	9	57^{o}
FjPi-29-10C-38	Mudstone End S.	30	25	20	39^{o}
FjPi-29-13C-39	P. Wood End S.	19	18	3	21^{o}
FjPi-29-3A-13	Chert? End S.	22	23	4	48^{o}